COMPARISON OF ENVELOPE, WARD'S AND MODIFIED WARD'S INCISION DESIGNS ON THE PERIODONTAL STATUS OF THE SECOND MOLAR FOLLOWING SURGICAL REMOVAL OF IMPACTED MANDIBULAR THIRD MOLARS

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CERTIFICATE

This is to certify that this dissertation titled **"COMPARISON OF ENVELOPE, WARD'S AND MODIFIED WARD'S INCISION DESIGNS ON THE PERIODONTAL STATUS OF THE SECOND MOLAR FOLLOWING SURGICAL REMOVAL OF IMPACTED MANDIBULAR THIRD MOLARS"** is a bonafide record of work done by **Dr. D. Abisheik Johnson Babu** under our guidance and to our satisfaction during his postgraduate study period **2010-2013.**

This Dissertation is submitted to **THE TAMILNADU Dr. M.G.R.MEDICAL UNIVERSITY,** in partial fulfillment for the award of the Degree of **MASTER OF DENTAL SURGERY – ORAL AND MAXILLOFACIAL SURGERY, BRANCH III.** It has not been submitted (partial or full) for the award of any other degree or diploma.

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ABSTRACT

PURPOSE:

The aim of the study was to compare the effects of envelope, ward's and modified ward's incision on the periodontal health status of the mandibular second molar before and after surgical removal of impacted mandibular third molars.

PATIENTS AND METHODS:

Thirty patients who require removal of mesioangular impacted mandibular third molars were included in the study. The periodontal health of the second molar was evaluated preoperatively, at 1 month, 2 months and 6 months postoperatively. Each flap design was used for 10 patients each. VAS scale was used to assess pain and sensitivity.

RESULTS:

There was a significant increase in the mean probing depth distal to second molar at the end of one month. There was a significant decrease in the mean probing depth at the end of six months when compared to the preoperative measurements. The preoperative and postoperative values of clinical attachment levels were similar. Plaque index and gingival index indicated improvement in oral hygiene after the third molar surgery. There was improvement in bone level postoperatively. VAS indicated reduced pain and sensitivity postoperatively.

CONCLUSION:

There was no significant difference between the three flap designs on the periodontal health status of the mandibular second molar before and after surgical removal of impacted third molar. There was improvement in the periodontal health status of the mandibular second molar after surgical removal of impacted mandibular third molar for all the three flap designs.

KEY WORDS: Envelope flap, ward's flap, modified ward's flap, probing depth, clinical attachment level.

Introduction

INTRODUCTION

Periodontal pathology is the outcome of the interaction of periodontal pathogens with the immune system at the Biofilm Gingival Interface (BGI).[64] The impacted lower third molar significantly increases the surface area of BGI. It favours more anaerobic environment which facilitates colonization by pathogens. Colonization of the exposed distal root of the second molar by periopathogenic bacteria eventually lead to the development of an infrabony lesion. Norton et al[63] and Hausmann et al[41] have shown the presence of bacterial endotoxins in the periodontal pocket and emphasized its role in inhibition of bone growth and alveolar bone resorption. In response, inflammation is enhanced at the affected anatomic sites and becomes chronic, and the portal to the systemic circulation widens, with an eventual systemic reaction to the chronic oral inflammation.

The optimal management of the impacted lower third molar is a highly relevant issue to maintaining the periodontal health of the adjacent lower second molar. Several authors have investigated the effect of impacted lower third molar extraction on the periodontal pockets distal to the adjacent second molar. Ash et al[9] have reported deepening of periodontal pockets of lower second molars following the surgical removal of partially or fully impacted lower third molar. Similar findings have later been shown by Ziegler[88] and Kugelberg[55] et al. In contrary, Szmyd and Hester[85] showed a decrease in pocket depth following third molar extraction. Similar results have been shown by Grondahl and Lekholm[32], Groves and Moore[33], Kugelberg et al[57], Stephens et al[81] and Woolf et al[87]. However Chin Quee et al[20],

Osborne et al[66] found no significant changes in pocket depths following impacted third molar extraction.

Blakey et al[28] suggested that third molar removal may improve the periodontal status of young adults with early stages of periodontal inflammatory disease, with beneficial changes particularly affecting the distal side of second molars as defined by all probing depth < 4mm on the distal side of second molars. Kugelberg et al[57] suggested that older age, angulation of the third molar relative to the adjacent second molar, and close contact between the third and second molars were associated with adverse periodontal outcomes.

The extraction of an impacted lower third molar is a surgical procedure which itself may cause periodontal damage to the adjacent tooth. The healing process depends on the flap design, oral hygiene, bone removal, angulation and position of the impacted tooth and the experience of the surgeon. Various flap designs like Envelope flap, triangular flap, three cornered flap, modified Szmyd flap have been discussed in the literature for the removal of impacted lower third molar. Flap design is particularly important not only to allow optimal visibility and access to the impacted tooth but also for subsequent healing of the surgically created defect. Based on the type of incision and flap design dehiscence can take place distal to the lower second molar during primary wound healing and this area may heal secondarily. Secondary wound healing can cause loss of attachment and gingival defects distal to the second molar.

In our study we evaluated the effect of envelope, ward's and modified ward's incision designs on the periodontal status of the second molar following surgical removal of the mesioangular impacted mandibular third molar.

AIMS AND OBJECTIVES

The investigation was done to compare the effects of Envelope, Ward's and Modified Ward's incision on the following:

- Periodontal health status of the mandibular second molar before and after surgical removal of mesioangular impacted mandibular third molar.
- Post operative complications

Review of Literature

REVIEW OF LITERATURE

The earliest publications regarding the implications of third molar extractions were put forward by **Robb**[71] in 1940. He mentioned about the injury to the second molar caused by the presence of the third molar. He discussed the resorption of second molar root and the lack of bone along the distal side, which rarely fills completely after the third molar extractions. This absence results in a pocket or a gingival recession that leads to periodontal pathology. He concluded that early removal of third molar could be done to improve the regenerative potential. He associated third molar with recurrent Vincent's infection because the partially impacted teeth harbor the micro organisms for number of years.

Ash et al[9] in 1961 studied the effect of the extraction of third molars on periodontal status distal to second molar. Their results from 225 extractions revealed that pocket formation on the distal aspect of second molar was more evident after extractions of completely erupted third molar.

A reduction in probing depths around mandibular second molars at 6 months and 12 months after extraction of the impacted third molars was found by **Szmyd** and **Hester**[85]. The probing depths were almost the same at both intervals.

The influence of flap design in regard to the periodontium of the second molar following third molar extraction that require bone removal was

examined by **Grooves** and **Moore**[33] in 1970. They observed no increase the pocket depth distal to the second molar especially when third molars were erupted prior to surgery. Yet, they did not present the numerical values of changes in pocket depth. Heaping was described as an accumulation of soft tissue distal to second molar. This condition was seen mostly related to non erupted teeth. The term vestibular interference referred to excessive scar tissue in the line of vertical relieving incisions. The vestibular interference was noted in 70% of the areas studied causing puckering in the buccal sulcus, thus reducing the depth of vestibule. Three different flap designs were suggested in this study which did not influence the bone loss distal to the second molar.

Szymd[84] in 1971 gave the advantages of the three cornered flap after comparing two standard mucoperiosteal flaps. There was no need to detach the free gingival fibers around the second and first molar leading the decreased amount reflected periosteum. Adequate blood supply to the flap was achieved. Adequate exposure and visibility achieved. Closure could be done with single suture placed at the distal aspect of the third molar.

Melcher A.H[60] in 1976 stated that the periosteal reflection should be minimized especially distal to second molar to avoid periodontal pocket formation.

In 1977, **Gool AVV** et al[30] presented a quantitative data on inter relationship of postoperative complaints about pain, trismus and swelling after removal of mandibular third molars. The study was conducted in 932 patients

including both extractions and surgical removals. It was concluded that there exists a strong but time dependent inter relationship between the complaints.

The result of a comparative study in which buccal extension flap was raised was supported by **Woolf** et al[87] in 1978. The patient was examined before and 6 months after the removal of impacted third molar. The results showed that if periodontal problems develop later one must look beyond flap designs for their occurrence.

The advantage of vertical flap (marginal) over envelope flap was described by **Kaminishi R.M** et al[46] in 1979 as there was a smaller area of periosteum that must be elevated. Access is adequate in most cases; the flap passively rests in an appropriate position without suturing.

Bruce RA[13] in 1980, investigated the incidence of operative and postoperative morbidity associated with the removal of impacted mandibular third molars in patients of various ages. They showed that there is a significant increase in surgical morbidity as the patient becomes older. The healing process was also slower in individuals 60 years and older compared with patients in their 20s.

A study to determine the effects of root planning and curettage on the crevicular depth and periodontal attachment at the distal surface of mandibular second molar following removal of adjacent impacted or partially erupted third molars was done by **Osborne** et al[66] in 1982. They concluded that root

planning and curettage of mandibular second molars immediately following removal removal of impacted mandibular molars is not so beneficial. The best means of preserving periodontal attachment on mandibular second molars may be the removal of third molars at an early stage of tooth development.

Haffajee et al[36] in 1983 evaluated the usefulness of clinical measurements of periodontal disease in predicting destructive periodontal disease activity. Clinical parameters related to periodontal disease activity include plaque accumulation, redness, swelling, bleeding on probing, suppuration on probing, crevicular fluid volume, pocket depth and attachment level. Attachment level measurements, bone loss and to some extent pocket depth reflect prior loss of attachment but not necessarily current destruction. Each of the clinical parameters at a single visit may provide information to the clinician in terms of extent of previous disease or current condition of gingival tissues.

Two types of access flaps used in removing mandibular third molars were compared by **R.Jeffary Stephens** et al[81] in 1983. There was no clinically significant difference between the two types of access flaps. The decision to use either of the flaps should be based on operator preference than on assuming that there is improvement of periodontal health status of the adjacent second molar.

Guralnick[35] in 1984 had observed that horizontal (envelope) incision to expose the mandibular third molar is better as it provides a good exposure and also eases closure.

Quee[20] in 1985 examined 30 patients after surgical removal of their impacted mandibular third molars using vertical (marginal) flap described by Thoma and the envelope flap described by Kruger. Six months post surgically both flap design group exhibited a statistically significant loss of attachment level on distal surface of second molar with no difference between the two flap groups.

Kugelberg CF et al[55] in 1985 retrospectively studied in 215 cases the effect on periodontal tissues of lower third molar surgery, due to impaction or semi-impaction. Both clinical and radiographic variables were examined 2years post operatively. Clinical variables included the amount of plaque, and presence of gingivitis and periodontal pockets. A higher incidence of plaque, gingivitis and pockets were observed on the distal surface of the second molar than on other surfaces of the first and second molars. The alveolar bone level distal to the second molar was registered by radiographic examination with a periodontal probe as indicator. 2 years post operatively, 43.3% of the cases exhibited pocket depths exceeding 7mm and 32.1% showed intrabony defects exceeding 4mm.

A retrospective study was done by **Kugelberg CF** et al[54] in 1986 to determine the effect of lower third molar surgery on periodontal tissues,

consisting of 215 patients, two years postoperatively. A methodological study was conducted in 25 patients to evaluate the precision and accuracy of radiographic assessment of intrabony defects on distal surface of lower second molars. They concluded that the radiographic method describes the depth of postoperative intrabony defects on distal surface of lower second molar more accurately than probing depth measurements alone.

A longitudinal radiographic study to describe the changes in bone level over two years in a group of subjects (18-68 years) was done by **Albandar** et al[2] in 1986. 94% of the sites did not show significant changes in alveolar bone level during the observation period and it was shown that the rate of bone loss increased rapidly between 33 and 56 years of age. It also revealed that the rate of bone loss increased with increasing initial bone loss.

Envelope flap and vertical (marginal) flap in mandibular third molar surgery was compared over a period of 1 year by **Schofield** et al[78] in 1988. There was no clear difference in periodontal health of second molar. They concluded that selection of the flap design for mandibular third molar surgery is dependent on the needs and preference of the surgeon and does not seem to have a lasting effect on the health of the periodontium on the distal of the second molar.

Kugelberg et al[56] in 1990, did a retrospective study on the long term effects on periodontal tissues of adjacent second molar resulting from impacted lower third molar surgery. The postoperative evaluation was done

using radiographic and clinical variables after two and four years post surgically. Oral hygiene status, gingival condition and periodontal tissue breakdown in terms of increased probing depths and infrabony defects were evaluated. Two years postoperatively, 16.7% of patients aged ≤ 25 years showed infrabony defects exceeding 4mm compared with 40.7% in patients aged ≥ 26 years. At four years postoperatively, the figures were 4.2% and 44.4% respectively. The alveolar bone level markedly improved in patients under 25 years of age. The age of the patient at the time of surgery was emphasized in the study. It was concluded that an early removal of impacted mandibular third molars might have a beneficial effect on periodontal health of the adjacent second molar.

In 1991, **Kugelberg** et al[57], evaluated the effects of impacted lower third molar surgery on periodontal tissues in the adjacent second molar area in a prospective study comprising 176 cases from 2 age groups: ≤ 20 years (n=93) and ≥ 30 years (n=83). The preoperative and 1 year postoperative examinations included both clinical and radiographic variables viz: Plaque index, Gingival index, Probing depth, Proximal bone level and Intrabony defects. All the patients were subjected to a standardized surgical procedure and optimal plaque control pre-, intra-, and post- operatively. The age of the patient at the time of surgery was found to be of utmost importance as regards to the prevalence of postoperative intrabony defects. It was concluded that early removal of impacted lower third molars with large angulation and close

positional relationship to the adjacent second molar proved to have a beneficial effect on periodontal health.

Kugelberg et al[58] in 1991, presented a study to identify some predictors of postoperative infrabony defects on distal surface of adjacent second molar after impacted mandibular third molar surgery. 144 patients with 215 lower third molar removals were included in the study. The postoperative evaluation was done two years after impaction surgery and included both clinical and radiographic variables. Statistically significant predictors of infrabony defects found were preoperative infrabony defects on distal of second molar, age at the time of surgery, size of contact area between second and third molar, root resorption of distal root of second molar, probing depth on distal surface of adjacent first molar postoperatively, and presence of pathological follicle in relation to mandibular third molar.

In 1992, **L.J.Peterson**[68] stated that a releasing incision can be made to gain wider access to remove a deeply placed impacted tooth as the envelope flap may not provide access. The envelope flap is associated with fewer complications and tends to heal more rapidly with less pain than the three cornered (marginal) flap. When a releasing incision is made it might also injure the buccal artery which would arise in bleeding.

The influence of incision and reflection of a flap on pain after the removal of partial erupted mandibular third molars was evaluated by **Clauster** et al[21] in 1994. The patients underwent bilateral extraction of partially

impacted mandibular third molars with a standard incision on one side (control) and without incision (test) on the other side. They concluded that non-surgical approach appeared to be an effective way of reducing postoperative discomfort after extraction of partially impacted third molars.

Kuang-Yao Peng et al[67] in 2001 evaluated the long term effects of impacted mandibular third molar extraction on the periodontal health of mandibular second molar in 57 patients. A comparison of the periodontal status was performed in two groups of mandibular second molars; with and without surgical extraction of impacted third molars. Greater periodontal breakdown including probing depth, attachment loss, and radiographic alveolar bone loss was found at the distal sites but not at the mesial sites of the experimental second molars, where the third molars were surgically extracted compared with the control teeth (no surgery). More radiographic bone loss was seen at the sites adjacent to the surgical location than other sites in the experimental molars. Hence they concluded that surgical removal of the impacted mandibular third molar may lead to a periodontal breakdown on the distal surface of the second molar. Periodontal re-evaluation after the initial healing of third molar extraction is indicated.

The influence of two mucoperiosteal flaps on the periodontal healing of adjacent second molars after surgical extraction of impacted mandibular third molars was done by **Rosa AL** et al[73] in 2002. In 14 patients with bilateral impacted mandibular third molars, an envelope incision with a releasing

incision anterior to the second molar (3-cornered flap) was used on one side and a Szmyd flap on the other side. the periodontal status of the second molars was evaluated before surgery and at 3 and 6 months post operatively. The pocket depth, clinical attachment level and bone level of the buccal and mesial surfaces of the second molars were measured using a William's periodontal probe. No statistical differences were found in comparing these measurements. But there was a significant increase in all three measurements from the 3 month to the 6 month post operative time. Hence they concluded that independent of the design of the mucoperiosteal flap used in extracting an impacted mandibular third molar, the periodontal condition of the adjacent second molar worsened from 3 to 6 months, although it remained within normal values.

Kan et al[47] in 2002 retrospectively studied the periodontal conditions distal to mandibular second molars 6-36 months after routine surgical extraction of adjacent impacted mandibular third molars. Patients were selected by systematic sampling from computer records of surgical mandibular third molar extractions. Selected patients were invited for an interview followed by a clinical examination. Community Periodontal Index (CPI) protocol was used for the assessment of the general periodontal status followed by a detailed periodontal examination of the mandibular second molar. In all 158 patients, a highest CPI score of 4 was obtained by 6% of the subjects but local periodontal defects were prevalent at the distal surface of the

mandibular second molars. Mean probing pocket depth (PPD) was 5.4 ±1.9mm with 67% subjects exhibiting PPD ≥ 5mm and 23% exhibiting PPD ≥ 7mm. mean recession was 0.8 ±1.0mm, bleeding on probing 96% and suppuration on probing 5%. Three possible risk indicators associated with localized increased PPD at the distal surface of the mandibular second molars were identified: 1) third molar mesioangular impaction 2) pre- extraction crestal radiolucency and 3) inadequate post operative local plaque control. They concluded that periodontal breakdown initiated and established on the distal surface of mandibular second molar in the presence of the above mentioned factors can predispose to a persistent localized periodontal problem.

Suarez-Cunqueiro MM et al[82] in 2003 compared marginal and paramarginal flap designs used during impacted third molar surgery. 27 patients with 4 impacted third molars were included in this clinical prospective study. A marginal flap was used in one half of the jaw and a paramarginal flap on the other half. The influence of these flaps on wound healing, periodontal pocket depth of adjacent second molar, pain, trismus and swelling was studied. The probing depths were similar with both techniques at 3 months. It was inferred that there was no advantage of the use of paramarginal flap instead of a traditional marginal flap for removing impacted third molars.

The periodontal healing of mandibular second molars after the removal of impacted mandibular third molars using distolingual alveolectomy and

tooth division techniques was compared by **Chang HH** et al[18] in 2004. A total of 120 consecutive healthy patients with bilateral impacted mandibular third molars were included in the study. The third molar on one side was removed using distolingual alveolectomy and the contralateral tooth was removed by the tooth division technique using burs. Clinical attachment level, periodontal pocket depth and bone healing distal to mandibular second molars were evaluated at 7 days, 3 months and 6 months after surgery. There was better periodontal as well as bone healing when distolingual alveolectomy was employed, especially in the removal of deeply impacted mandibular third molars.

In 2004, **Coll AM**, **Ameen JR**, **Mead D**[22] critically reviewed some of the available objective and subjective measures of pain. They established the suitability of a Visual Analogue Scale (VAS) for measuring the intensity of pain after day surgery. The VAS was found to be methodologically sound, conceptually simple, easy to administer and unobstructive to the respondent. The VAS was hence seems to be most suitable for measuring intensity of pain after day surgery.

Thomas BD et al[86] in 2004, studied the efficacy of demineralized bone powder (DBP) or guided-tissue regeneration therapy (DTR) in preventing periodontal defects on the distal aspect of mandibular second molar following surgical extraction of impacted third molars in patients $\geq$ 26 years of age who require bilateral impacted mandibular third molar removal. Each subject was

randomly assigned to receive either DBP or GTR therapy. Within subjects, one third molar site was randomly selected to be the experimental site and the opposite third molar served as a control and was allowed to heal without intervention. The primary outcome variable was the change in attachment levels and probing depths on the distal aspect of mandibular second molar preoperatively and 26 weeks postoperatively. The results suggested that the attachment levels and probing depths improved after impacted third molar removal and DBP or GTR therapy did not offer predictable benefit over no treatment.

In 2005, **Krausz** et al[52], evaluated the long term changes in periodontal health and alveolar bone height distal to the adjacent second molar following extraction of an impacted third molar. This split mouth study included 25 patients who underwent extraction of one mandibular impacted third molar (test), whereas the opposite tooth remained intact (control). Pre- and post-operative panoramic radiographs were then scanned and alveolar bone height was digitally measured on the distal aspect of second molar. Clinical measurements consisted of plaque index, gingival index, periodontal pocket depth, gingival margin position and clinical attachment level. All clinical parameters seemed to be unchanged. They concluded that extraction of an impacted third molar resulted in significant gain of alveolar bone height on the distal aspect of the adjacent second molar on the test side whereas slight bone loss was noted on the control side.

The risk of having periodontal defects on the distal aspect of mandibular second molar after removal of impacted third molar was studied by **Richardson.D**[70] in 2005. After reviewing 8 articles, he reported that mean changes in the attachment levels and periodontal probing depths distal to mandibular second molar 6 months after surgical removal of impacted mandibular third molar were clinically insignificant. Given healthy periodontal status preoperatively, 48% of the patients had worsening of their periodontal measures after mandibular third molar removal. He concluded that the indication for third molar removal needs to be evaluated carefully for subjects with healthy periodontium preoperatively as these subjects have an increased risk for worsening of probing depths or attachment levels after third molar removal.

Platelet-rich plasma (PRP) is a material containing many autologous growth factors that may be used in repairing and preventing periodontal complications at the distal root of the second molar adjacent to the extracted third molar. **Sammartino G** et al[76] in 2005 analyzed the effects of autologous PRP on periodontal tissues after extraction of the third molar in 18 young patients. They observed, at 12 weeks after surgery, a notable reduction in the probing depth and an improvement in the probing attachment level in those cases treated with PRP compared with the controls, as well as formation of new bone tissue in the bone defect. They showed that PRP is effective in inducing and accelerating bone regeneration for the treatment of periodontal

defects at the distal root of the mandibular second molar after surgical extraction of a mesioangular, deeply impacted mandibular third molar.

The effect of flap design in terms of periodontal status of the preceding second molar after lower third molar surgery was reviewed by **I.Karaca**[48] in 2007. He stated that periodontal complications on the distal surface of the adjacent second molar may arise after the impacted lower third molar surgery. Flap designs like triangular, marginal, vertical flaps and their modifications have been developed to minimize these complications. It is also reported that selection of a flap design does not seem to have a lasting effect on the health of periodontal tissue. The effects of these flaps used on the periodontal status of the second molar have been uncertain. The decision to use any of the available flaps should be based on the surgeon's preference.

In 2007, **Tugrul Kirtilogu** et al[50], compared the effects of two flap designs on the periodontal health status of the mandibular second molar after the extraction of adjacent third molar. The third molars were removed using the 3 cornered flap on left side and modified Szmyd flap on the right side. The mean probing depth at distal and buccal sites was significantly different between the flaps at 1, 2 and 4 weeks postoperatively. There was no significant difference in preoperative and 1 year postoperative probing depth between the 2 flaps. They concluded that the modified Szmyd flap which leaves intact gingiva around the second molar has better primary periodontal healing than the 3 cornered flap.

In 2008, **Nardy** et al[62] evaluated the effect of informed consent on stress levels associated with removal of impacted mandibular third molars. A total of 60 patients scheduled for extraction were included in the study. Data from 20 patients established the baseline levels of electrodermal activity (EDA). The remaining 40 patients were randomly assigned into 2 equal groups receiving either a detailed document of informed consent, disclosing the possible risks involved with the surgery, or a simplified version. Pulse, blood pressure, and EDA were monitored before, during, and after completion of the consent document. A greater increase in EDA was associated with the detailed version of the consent document. The results suggest that over detailed listing and disclosure before extraction of impacted mandibular third molars can increase patient stress.

Michael RM et al[61] in 2008, studied the effects of corticosteroids on edema, trismus and pain at early and late postoperative periods after surgical removal of impacted third molars. The primary predictor variable was perioperative corticosteroid exposure (yes or no). The 3 outcome variables were edema, trismus, and pain assessed during the early (1-3 days) and late (>3 days) postoperative time periods. They concluded that perioperative administration of corticosteroids produces a mild to moderate reduction in edema and improvement in range of motion after impacted third molar removal.

In 2009, **Guiseppe Monaco** et al[29], evaluated the influence of two different flap designs on periodontal healing and postoperative complications, after mandibular third molar removal in young patients. 12 patients underwent 2 extractions, using a triangular flap on one side and an envelope flap in the other. Periodontal probing depth, operating time and post operative complications were recorded. Deeper probing depth was seen after 7 days in all teeth examined. This increase was statistically greater for the first and second molars when an envelope flap was used. After 3 months, probing depth returned to preoperative values. The average operating time for triangular flap was less than that of envelope flap. After 6 months, the 2 flap designs resulted in no difference in periodontal healing or complications but 30% of the surgical extractions resulted in a debilitating postoperative period for the patients treated. They concluded that significant differences in probing depth between triangular and envelope flaps 7 days after the extraction of impacted mandibular third molars was not important from clinical perspective, because periodontal healing at 3 and 6 months was comparable. Another important finding was the presence of a debilitating postoperative period in most of the patients who underwent surgical extraction, contrary to the belief of many surgeons.

George Blakey et al[28] in 2009, assessed the impact of mandibular third molar removal on periodontal pathology in subjects with third molars asymptomatic at enrollment. Subjects in whom at least 2 third molars were

removed were a subsample of healthy young subjects enrolled with 4 asymptomatic mandibular third molars. Full mouth periodontal probing data, 6 sites per tooth, were obtained as a measure of periodontal status at each of 3 visits: enrollment, before removal of mandibular third molars, and after removal of mandibular third molars. The oral cavity was divided into segments: the third molar region including the third molar (12 sites), distal to second molar (4 sites), and non-third molars (80 sites). A probing depth of $\geq$ 4mm was considered an indicator variable for periodontal pathology. The number and percentage of sites with a probing depth $\geq$ 4mm were calculated. The frequency of subjects with at least one probing depth $\geq$ 4mm and all third molars removed were compared with the frequency of subjects retaining at least one mandibular third molar. Significantly fewer subjects who had all third molars removed had a probing depth $\geq$ 4mm on the distal of their second molars after surgery, compared with those retaining at least one mandibular third molar. The number of probing depth $\geq$ 4mm in the mandible was less after surgery if all the third molars had been removed. Hence it was concluded that removal of mandibular third molars significantly improved the periodontal status on the distal of mandibular second molars, positively affecting overall periodontal health.

A study was done to depict surgical difficulties related to third molar removal with symptoms and signs presented by postoperative patients, identifying the most frequent occurrences and postoperative complications to

prevent them or lessen their intensity by **Fabio** et al[27] in 2009. Data were acquired from questionnaires answered by patients and surgeons after surgery. A total of 128 patients participated in this study, answering questionnaires regarding postoperative signs/symptoms on a daily basis for a period of 7 days. Surgeons answered a questionnaire about the surgical procedure. Main patient complaints were related to swelling and bad taste/breath, considering that the former was more intense during the first days after operation, and the latter lingered during the 7-day postoperative period of research. Mouth opening (trismus) and eating were the main activities affected by third molar extraction Results show that during the first postoperative week some patients may experience quality reduction in their daily activities. Considering that objective (ie, surgery duration) and subjective (ie, difficulties during surgery) indicators were not related to postoperative pain, it was concluded that all patients are entitled to knowing that their lifestyles may be negatively affected by the after-effects, contributing to a better professional-patient relationship.

In 2009, **Hazza'a AM** et al[42] investigate the association between pericoronitis and the angular position, state of eruption, and the depth of impaction of mandibular third molars as well as to compare these findings with similar studies. A total of 242 patients ranging in age from 18 to 41 years of age suffering from pericoronitis were examined. Subjective and objective observations were recorded on a checklist that included the name, age, gender, type of pericoronitis and state of eruption, position of the affected tooth for

each patient as well as any radiographic changes in the mandibular third molars. The peak age for the occurrence of pericoronitis was in the 21-25 year-old age group. The soft tissues adjacent to vertically inclined, partially erupted mandibular third molars were more frequently affected by pericoronitis than teeth that are soft tissue impacted or erupted. Mesioangular erupted third molars were the teeth most frequently associated with bone loss.

In 2010, **Carolyn Dicus** et al[14], assessed the prevalence of periodontal inflammatory disease on the distal side of second molars after third molar removal and the association between pre surgical, surgical variables and postsurgical periodontal outcomes. Data from 2 studies were used. In one study, 26 subjects had 4 asymptomatic third molars and the other 49 subjects had at least 1 mandibular third molar with symptoms of pericoronitis. Full mouth periodontal probing data, 6 sites per tooth were obtained before and after surgery. Probing depth of $\geq$ 4mm in at least 1 site distal to second molar was chosen to indicate periodontal inflammatory disease. Periodontal health was defined as all distal to second molar probing depth < 4mm. A postsurgical change in distal to second molar probing depth > 2mm with resulting probing depth $\geq$ 4mm was considered an indicator of periodontal inflammatory disease. Age, time intervals, ethnicity, gender and clinical data were other variables examined. It was concluded that after third molar removal, periodontal inflammatory disease on the distal to second molars was detected significantly less often. None of the variables examined except for pre surgical

presence of distal to second molar probing depth of $\geq$ 4mm were significantly associated with postsurgical distal to second molar periodontal inflammatory disease.

The influence of primary and secondary closure of the surgical wound on postoperative pain and swelling after removal of impacted mandibular third molars was done by **Anil Kumar** et al[8] in 2010. A total of 93 patients with bilaterally impacted mandibular third molars were included in the study. Primary closure (group I) was performed on one side and secondary closure (group II) was performed on the other side. All the patients were assessed for pain and swelling using the visual analog scale 7 days after the surgery. The patients in the secondary closure group had a significantly lesser amount of pain and swelling postoperatively than the primary closure group.

In 2010, **Sandhu** at al[77] compared the effects of flap design on the postoperative sequelae of pain, swelling, trismus and wound dehiscence after surgical removal of bilateral impacted mandibular third molars. 20 patients aged 20–30 years who required removal of bilateral impacted mandibular third molars were included in the study. Bayonet flap was used on one side and envelope flap on the other side for the removal of impacted mandibular third molar. The bayonet flap was superior to the envelope flap for postoperative pain and wound dehiscence. There was no difference in postoperative swelling and trismus between the two groups.

In 2010, **Carolina** et al[15] assessed the pain and swelling during the first week after surgical extraction of impacted mandibular third molars and the relationship with oral hygiene and smoking before surgery and during the postoperative period. A prospective study was performed on patients undergoing surgical extractions of impacted mandibular third molars. Pain was recorded on a visual analog scale from 1 to 10 and swelling on a 4-point descriptive scale at 2, 6, and 12 hours after surgery and daily during the first postoperative week. Oral hygiene and smoking before surgery and during the postoperative period were recorded. A total of 50 patients underwent surgical extraction of an impacted third molar. The maximum pain occurred during the first day and the maximum swelling at 24 hours after surgery. The patients with a lower brushing frequency before surgery reported greater pain. Likewise, the patients who smoked more after surgery experienced greater pain at 24 hours postoperatively. It was concluded that surgical extraction of an impacted third molar caused moderate pain and swelling during the first 24 hours after surgery. A lower brushing frequency before surgery and during the first postoperative week as well as smoking after surgery was related to greater pain scores.

Haraji et al[37] in 2010 evaluated the influence of flap design (modified triangular flap or buccal envelope flap) on alveolar osteitis and on healing following the surgical removal of an impacted mandibular third molar. A double-blind split-mouth clinical trial examined 17 patients with bilateral

impacted third molars. A modified triangular flap was placed on one side and a buccal envelope flap (control) was placed on the other side. Alveolar osteitis and healing were assessed at three and seven days after surgery. The modified triangular flap decreased the incidence of alveolar osteitis and expedited healing at seven days post surgery.

Amarillas-Escobar ED et al[4] in 2010 evaluated the effectiveness of a therapeutic laser in the control of postoperative pain, swelling, and trismus associated with the surgical removal of impacted third molars. A double-blind, randomized, controlled clinical trial was conducted in 2 groups of 15 patients each undergoing surgical removal of impacted lower third molars under local anesthesia. The experimental group received 4 J/cm(2) of energy density intraorally and extraorally, with a laser with a diode wavelength of 810 nm and output power of 100 mW in a continuous wave. The control group received only standard management. The experimental group exhibited a lower intensity of postoperative pain, swelling, and trismus than the control group. The use of therapeutic laser in the postoperative management of patients having surgical removal of impacted third molars decreased postoperative pain, swelling, and trismus.

Lopez-Cedrun et al[45] in 2011, compared the occurrence of postoperative complications in patients receiving either pre- or postoperative amoxicillin versus placebo after surgical extraction of impacted mandibular third molar. A randomized, double-blind, placebo-controlled clinical trial was

performed in 123 patients undergoing third molar surgery. The patients were randomized to 3 groups, according to the treatment regimen: preoperative amoxicillin, postoperative amoxicillin, and placebo. The clinical outcomes, including pain, wound infection, trismus, temperature, intra- and extraoral swelling, dysphagia, side effects, and postoperative complications, were assessed. Statistically significant differences were found in the incidence of pain, wound infection, temperature, trismus, and dysphagia between the groups receiving amoxicillin versus placebo. No significant differences in swelling and side effects were found among the different groups. It was concluded that Amoxicillin administered pre- or postoperatively demonstrated greater efficacy than placebo in preventing postoperative complications in patients undergoing third molar surgery. The best results were obtained using the postoperative protocol.

In 2011, **Seidu AB** et al[79] compared the effect of total and partial wound closure techniques on immediate postoperative tissue reactions and complications after mandibular third molar surgery. 82 patients were included in the study, 54 males and 28 females. Patients were randomly allocated to partial (group I) and total (group II) wound closure groups. Data were collected on pain, trismus, swelling, and complications experienced by the patients. The partial wound closure technique after third molar surgery was considered to be associated with more postoperative morbidity, in view of the distressing nature of reactionary bleeding that was found to be associated with

it. However, patients should be adequately informed about the possibility of attendant facial swelling each time the technique of total wound closure is used.

The change in the periodontal status of mandibular second molars after surgical extraction of adjacent impacted lower third molars was evaluated by **Javier Montero**[44] in 2011. The study was based on a 1-year follow-up of 48 patients (20 men and 28 women) recruited consecutively after the extraction of an impacted lower third molar. Panoramic radiographs were obtained and clinical examinations were carried out at baseline to determine the periodontal status using probing depth and dental plaque and gingival indices both for the second molar and for the 4 posterior sextants. After surgical removal of the impacted mandibular third molars, all patients were assessed at 3, 6, 9, and 12 months for changes in periodontal status. The periodontal health of the second molar was found to improve gradually after third molar surgery in all clinical parameters. They concluded that the initial periodontal breakdown established on the distal surfaces of the second molars and in the periodontal health of the 4 posterior sextants can be significantly improved 1 year after surgical removal of the ipsilateral lower third molar.

Omer Waleed[65] in 2011, compared the effect of submucosal versus intramuscular administration of dexamethasone sodium phosphate on patients' quality of life after surgical removal of impacted lower third molars. A randomized, non-blind, clinical trial was planned. The patients were randomly

distributed into 1 of 3 groups: submucosal dexamethasone, intramuscular dexamethasone, and a control group that received no steroid. A modified translated questionnaire was used to assess the patients' perception regarding different quality of life dimensions. In addition, the objective measurements of facial pain, swelling, and trismus were performed on days 1, 3, and 7 postoperatively. Both dexamethasone groups showed a significant reduction in swelling and pain compared with the control group at all intervals. Submucosal dexamethasone provided significant improvement in trismus compared with the control group on day 1 postoperatively. They concluded that submucosal injection of dexamethasone 4 mg is an effective therapeutic strategy for improving the quality of life after surgical removal of impacted lower third molars with a comparable effect on postoperative sequelae to intramuscular injection. It offers a simple, safe, painless, non-invasive, and cost effective therapeutic option for moderate and severe cases.

In 2011, **Ricardo WC**[69] presented a study to adjust a multivariate model to explain each of the response variables for the occurrence of surgical difficulty during the removal of impacted lower third molars. A prospective cohort study was carried out involving patients submitted to at least one surgical removal of an impacted lower third molar. A total of 285 patients fulfilled the eligibility criteria and 473 surgeries were performed. Preoperative variables indicative of surgical difficulty were recorded. All surgical procedures were performed under the same conditions by two surgeons who

were unaware of the data collected in the pre-selection phase. Root number and morphology, tooth position, periodontal space and second molar relation were significant predictors of surgical difficulty, whereas patient age gender, body mass index, associated pathologies, relation with mandibular canal and width of 3rd molar crown were not significant predictors. Many factors contribute to surgical difficulty, but considering these factors individually, some are only determinants of either difficulty or complications. Thus, not all significant predictors of surgical difficulty should be considered indicators of complications.

Khande K et al[49] in 2011, evaluated the primary and secondary closure techniques after surgical removal of impacted third molars in terms of healing, postoperative pain and swelling. 60 patients with impacted mandibular third molars were randomly divided into two groups of 30. Panoramic radiographs were taken to assess degree of eruption and to assess third molar angulations to the long axis of second molar. Teeth were extracted and in group I the socket was closed by hermetically suturing the flap. In group II a 5-6mm wedge of mucosa distal to second molar was removed and repositioned. Interrupted sutures were given forming a triangular opening of 5x5mm distal to second molar. Swelling and pain were evaluated for 7 day after surgery with the VAS scale. Pain, swelling and trismus were considerably less in secondary closure group. They concluded that in case of equal operative difficulty, open healing of surgical wound after removal of

impacted third molars produced less postoperative swelling and pain than occurs with closed healing, by hermetically suturing the socket.

In 2011, **Sridhar** et al[80] evaluated the perioperative use of 0.2% chlorhexidine gluconate for the prevention of alveolar osteitis, to assess the patient compliance to chlorhexidine and to prepare a comprehensive treatment plan to prevent alveolar osteitis after surgical removal of impacted mandibular third molar. A prospective study was done on 50 patients who require bilateral impacted mandibular third molars which were indicated for extraction. Extraction on one side was done without using any mouth rinse. While extracting on the opposite side, patients were instructed to use chlorhexidine 0.2% (rexidine) mouth rinse for 30 seconds twice a day with 15mL of the rinse with 1:1 dilution in clear water. All the patients were evaluated for pain, presence or absence of clot and condition of the alveolar bone for the diagnosis of dry socket. The incidence of dry socket was 8% when the patients did not use the mouth wash and it was statistically significant. They conclude that the incidence of dry socket can be reduced significantly by using 0.2% chlorhexidine gluconate mouth rinse after surgical extraction of impacted mandibular third molars.

Ana et al[5] in 2011, described a modified device for intraoral radiography which was developed to obtain reproducible radiographic images for assessment of distal osseous defects of the mandibular second molar after impacted third molar surgery. A commercial available alignment system for

posterior region was modified by adding a reference gauge pin and threading a hollow acrylic cylinder at the ring of the radiographic positioner to attach the X-ray collimator. A customized acrylic resin stent was of 2mm was included in the design. This technique provided standard periapical radiographs with a moderate to high resolution, repeatability and accuracy. This technique allowed better reproducibility in posterior radiographic records distal to second mandibular third molars and more accurate measurements of radiographic bone level by the use of millimetre pin.

In 2011, **Gupta** et al[34] evaluated impacted mandibular third molars for their angulation, level of eruption, third molar space and relation of inferior alveolar canal with their roots. Panoramic radiographs were obtained after written consent and traced. Out of 578 individuals 307 (53.11%) were males and 271 (46.89%) females. Maximum number of IM3M were in 18-27 years age group (398 i.e. 68.89%). Out of 988 IM3M, 39.93% were vertically placed. 61.84% IM3M were found at level A. Class II (79.65%) was the most common relation for third molar space. They concluded that panoramic radiographs can be used as reliable investigation for evaluation of impacted mandibular third molars.

Surgical removal of impacted third molars remains the most common procedure performed by oral and maxillofacial surgeons. Given the abundance of host bacteria within the operative sites, surgical site infections are among the most common complications of third molar removal, with an estimated

frequency of 1% to 30%. **Susarla** et al[83] in 2011, studied the effects of antibiotics on the frequency of surgical site infection after impacted mandibular third molar. A comprehensive review of the available data on antibiotic prophylaxis in impacted third molar surgery was done and specific recommendations on antibiotic use given.

The association between bone quality and fracture risk in the mandibular angle with the presence of impacted/semi-impacted third molars and after their extraction is controversial. **Alonso** et al[3] in 2011 assessed mandibular bone quality in digital radiographies of patients after extraction of impacted/semi-impacted lower third molars. A total of 130 sets of digital panoramic radiographies were selected and divided into the following three groups: Group 1 with 50 panoramic radiographies of patients with impacted/semi-impacted lower third molars, Group 2 with 30 panoramic radiographies of patients with lower third molar agenesis, and Group 3 with 50 panoramic radiographies of patients after extraction of impacted/semi-impacted lower third molars. The mandibular angular cortex was the anatomical structure used as parameter for bone quality assessment. It was concluded that the absence of impacted/semi-impacted lower third molars, was associated with a significant increase in cortical width.

Hassan et al[39] in 2011, evaluated the clinical and radiographic measurements of mandibular first molar bone support after mandibular third and second molar extraction and immediate augmentation of the extraction site

with a combined autogenous bone graft with Bio-Oss materials. A pyramidal full-thickness mucoperiosteal flap with one distal releasing incision was used for removal of impacted third and second molars. The osseous defects distal to first molar and extraction site was filled with the composite bone graft and covered with Bio-Gide membrane. After 1 year, there was a successful defect regression and gain of bone and clinical attachment level. Moreover, there was a reduction of probing pocket depth and gingival inflammation. They concluded that grafting of osseous defects and extraction site with autogenous bone graft combined with Bio-Oss materials will predictably result in a decreased risk of developing a periodontal defect on the distal aspect of mandibular first molar.

Briguglio et al[12] in 2011 compared the influence of three full-thickness flaps on the periodontal healing of the adjacent second molar after extraction of impacted mandibular third molars. 45 patients with bilateral impaction of the mandibular third molars were selected. Each patient was randomly assigned to one of three groups: group A (envelope flap modified by Thibauld and Parant), group B (Laskin triangular flap), and group C (envelope flap modified by Laskin). The periodontal health of the second molars was evaluated at 3, 6, 12, and 24 months after surgery via clinical measurements. There was a statistically significant reduction of pocket probing depth and increase of clinical attachment level in group B compared to the other groups 24 months after surgery. They concluded that regardless of the flap design, the

periodontal conditions of the adjacent second molar deteriorated after 12 and 24 months.

The influence of triangular and envelope flaps on trismus, pain, and facial swelling after mandibular third molar surgery was done by **Erdogan** et al[26] in 2011. 20 patients were operated with envelope flap on one side and triangular flap on the other side. Trismus was determined by measuring maximum interincisal opening, and facial swelling was evaluated using a tape measuring method. Pain was determined using visual analog scale (VAS) and recording the number of pain pills taken. Envelope flap yielded to less facial swelling and reduced VAS scores in comparison to triangular flap. There was no clinical difference in trismus between the two flap designs. Despite the higher VAS scores with triangular flap, no additional doses of analgesics were required in triangular flap.

Corinaldesi et al[23] in 2011 compared the healing of periodontal intrabony defects at distal surfaces of mandibular second molars using bioabsorbable and non-resorbable membranes. Eleven patients with bilateral probing depths ≥6 mm distal to mandibular second molars and intrabony defects ≥3 mm, related to the total impaction of mandibular third molars, were treated with mandibular third molar extraction and covering of the surgical bone defect with a bioabsorbable collagen barrier on one side and a non-resorbable expanded polytetrafluoroethylene (ePTFE) barrier contralaterally. Bioabsorbable collagen membranes in guided tissue regeneration treatment of

intrabony defects distal to the mandibular second molar obtained the same marked PD reductions and CAL gains as non-resorbable ePTFE membranes after impacted mandibular third molar extraction.

The surgical removal of impacted mesioangular mandibular third molars may produce trauma to the soft tissues and bony structures. In particular, healing of post extraction socket may cause periodontal defects at the distal root of the second molar. **Ruga** et al[74] in 2011 assessed the outcomes of a surgical protocol to remove mandibular third molars including the use of ultrasound bone surgery devices and platelet-rich fibrin (PRF) as a grafting material. In the study group, alveolar socket fulfilment was rated as sufficient in 4 cases and adequate in the remaining 10 cases, whereas in the control group, it was rated as insufficient in 3 cases, sufficient in 4 cases, and adequate in 7 cases. Mean preoperative periodontal probing in the control group was 3.78 mm, whereas in the study group, it was 3.93 mm. Six months after surgery, mean periodontal probing was 3.28 mm in the control group and 3.07 mm in the study group. They concluded that combined action of PRF and piezoelectric surgery can be considered a safe and fine technique for third molar surgery and alveolar socket healing.

Chen ZF[19] in 2011 investigated the effects of tissue engineered bone scaffold material in the restoration of alveolar socket after extraction of lower impacted third molar. Thirteen patients were immediately implanted with Bio-oss or PerioGlas in the alveolar cavity after impacted mandibular third molar

extraction. Clinical observation and X-ray were taken 1 to 12 weeks after operation. Thirteen patients did not experience postoperative complications. The distal alveolar height of the second molar and the gingival attachment did decrease significantly 1 to 12 weeks after operation. They concluded that tissue engineered bone scaffold material is helpful in the restoration of alveolar socket after impacted third molar extraction.

Pain, swelling, trismus, and alveolar osteitis often occur after removal of impacted third molar teeth. To minimize these complications a number of mucoperiosteal flap designs have been advocated, but, to date, a pedicle flap design has not been evaluated. **Sam MG** et al[75] in 2012 evaluated the influence of pedicle flap design on acute postoperative sequelae after surgical extraction of impacted mandibular third molars. 52 patients with bilateral symmetrically impacted mandibular third molars were included in the study. A buccal envelope or pedicle flap was randomly assigned to the left or right third molar site. Pre-and postoperative pain and swelling were recorded using a standardized visual analogue scale, trismus was measured as the maximum inter-incisal opening distance in millimetres and dry socket was assessed clinically. The pedicle flap improved some aspects of postoperative pain experience and reduced the incidence of alveolar osteitis, but further investigation with a larger sample size is required to evaluate its significance.

In 2012, **Aznar-Arasa** et al[10] compared the analgesic and anti-inflammatory effects of preoperative and postoperative administration of

ibuprofen after the surgical removal of impacted lower third molars. A triple-blind, randomized, placebo-controlled clinical trial of 120 patients requiring the surgical removal of lower third molars was performed. The subjects were randomized into the experimental group in which patients were administered 600 mg of ibuprofen 1 hour before the surgical procedure, followed by placebo just after the end of the operation or into the control group where the subjects received the same medication but the administration sequence was reversed. Pain was assessed using visual analogue scales, and consumption of rescue analgesic. The facial swelling and trismus were evaluated by measuring facial reference distances and maximum mouth opening. The preoperative intake of ibuprofen does not seem to reduce pain, facial swelling and trismus after impacted lower third molar removal when compared to the postoperative administration of the same drug.

The effects of two commonly used flap designs (envelope and triangular) used for the removal of mandibular third molars on postoperative morbidity was investigated by **Baqain** et al[11] in 2012. 19 patients with bilateral symmetrically impacted mandibular third molars were studied using a split mouth design. Swelling, pain and trismus measures were recorded on days 2, 7 and 14; periodontal indices were recorded on days 7 and 14, one final measure of probing depth on the distal aspect of the mandibular second molar was taken at the last follow up appointment. There was no significant difference in pain scores, plaque accumulation and bleeding on probing

indices between the two flap designs. Probing depth was significantly greater with envelope flaps in the early postoperative period. They concluded that flap design in mandibular third molar surgery had an effect on postoperative recovery.

In 2012, **Ana IF** at al[6] estimated the prevalence of preoperative periodontal defects and analyzed 12-month spontaneous healing on the distal aspect of the mandibular second molar after impacted mandibular third molar extraction. This prospective clinical study was conducted in 25 healthy young patients with 40 extractions of higher-risk periodontal impacted mandibular third molars. Plaque and gingival indices, recession, bleeding on probing, probing depth , and attachment level were recorded before surgery and at 3, 6, and 12 months after surgery at 5 sites on the distal aspect of the mandibualr second molar. The initial mean probing depth was 5.70 ± 3.80 mm, with the deepest mean probing depth at the lingual side. At 12 months, a mean probing depth average of 3.77 ± 2.86 mm was recorded, with a total average recovery of 1.93 ± 2.46 mm, that was higher at 3 months. The PD and attachment level improvements were statistically significant. It was concluded that impacted mandibular third adjacent to mandibular second molars lead to periodontal defects that are deepest at the lingual side and almost recover at 12 months after extraction. The first 3 months is considered the cutoff for periodontal healing. Young adults with high-risk periodontal mandibular third molar

impactions may benefit from early extraction, which increases spontaneous periodontal healing.

In 2012, **Romina BP** et al[72] investigated the efficacy and safety of low-level laser energy irradiation (LLEI) for decreasing pain, swelling, and trismus after surgical removal of impacted mandibular third molars. Ten eligible trials were included in this systematic review. Because of heterogeneity in the intervention and outcomes assessments, pain and swelling outcomes were only qualitatively summarized and indicated no beneficial effects of LLEI over placebo. Patients receiving LLEI had an average of 4.2 mm and 5.2 mm less trismus than patients receiving no active treatment on the second and seventh day after the surgery, respectively. There was no benefit of LLEI on pain or swelling and a moderate benefit on trismus after removal of IMTMs. It is necessary to standardize the intervention and outcomes assessment and to conduct adequately powered, well-designed trials to evaluate the efficacy of LLEI.

Dolanmaz D et al[25] in 2012, evaluated the effect of two flap designs (envelope and modified triangular flap) on postoperative pain and swelling after impacted mandibular third molar surgery. 30 patients who had bilateral impacted mandibular third molars were selected. Left teeth were approached with an envelope flap and right teeth were removed using a modified triangular flap. Pain and postoperative swelling were reviewed until the 7th day postoperatively. There was no significant difference between the envelope flap

and modified triangular flap designs on postoperative pain and swelling after impacted third molar surgery.

Koyuncu et al[51] in 2012, estimated the effects of flap design on alveolar osteitis and post operative side effects on third molar surgery. 80 patients with impacted mandibular third molars were included in the study. Envelope flap and modified triangular flap were compared. The primary outcome variable was alveolar osteitis and the secondary outcome variables were pain, swelling and trismus. Envelope flap had higher incidence of alveolar osteitis that was not statistically significant. On the second day, postoperative pain and swelling were significantly higher. They concluded that modified triangular flap had the advantage of less postoperative pain and swelling but had the disadvantage of alveolar osteitis.

Corticosteroids are frequently administered to reduce trismus and swelling after dentoalveolar surgical procedures. **Acham** et al[1] in 2012, evaluated the influence of a single, preoperative oral application of methylprednisolone on postoperative trismus, pain intensity and the subjective need for analgesic medication after surgical removal of impacted mandibular third molars. 60 healthy patients requiring similar bilateral impacted mandibular third molars were included in the study. At random, each patient received either weight dependant methylprednisolone (40-80mg) or a placebo 1 hour prior to surgery. Trismus, pain and swelling were measured on a 100mm visual analogue scale and the postoperative demand for analgesics was

assessed. Significant reduction of trismus, swelling, pain intensity and patient-controlled intake of analgesics during the whole postsurgical period (1-7days) were observed. It was concluded that a single preoperative weight dependant administration of methylprednisolone is a safe and effective concept for diminishing postoperative discomfort, pain intensity, and the total intake of analgesics after surgical removal of impacted mandibular third molars.

Hassan et al[40] in 2012, evaluated the use of xenograft and a membrane as grafting material for periodontal osseous defects distal to the mandibular second molar compared with non-grafted extraction sites after the surgical removal of impacted third molar. Patients aged 30-35 years who had high risk of periodontal osseous defects distal to mandibular second molar was included in the study. The outcome variables were change in gingival index, pocket probing depth, and clinical attachment level on the distobuccal aspect of second molar preoperatively, and at 3, 6, 9 and 12 months postoperatively. There was statistically significant gain in the clinical attachment level and a reduction in probing depth in grafted sites compared with non-grafted sites. Grafting of osseous defects distal to mandibular second molars with xenograft plus a membrane could prevent periodontal disease in the future.

Hashemi et al[38] in 2012, evaluated the influence of sutureless and multiple-suture closure of wounds on postoperative complications after extraction of bilateral, impacted, mandibular third molars in 30 patients in a split mouth study. After the teeth had been removed, on one side the flap was

replaced but with no suture to hold it in place (study side), and on the other side the wound was closed primarily with three sutures (control side). Recorded complications included pain, swelling, bleeding, and formation of periodontal pockets. The patients had significantly less postoperative pain and swelling when no sutures were used. There were no signs of excessive bleeding or oozing postoperatively on either side. Six months postoperatively there was no significant difference in the depth of the periodontal pocket around the second molar.

Goyal M et al[31] in 2012 compared the use of a conventional rotary handpiece and a Piezosurgical unit for extraction of lower third molars. They studied 40 patients, who were allocated alternately to have the third molar removed with either the handpiece or the Piezosurgical unit. Pain, trismus, and edema were evaluated at baseline and then postoperatively, together with paraesthesiae, on postoperative days 1, 3, 5, 7, and 15. Their results suggest that apart from some inherent limitations with the Piezotome, it is a valuable alternative for extraction of third molars.

Célio-Mariano R et al[17] in 2012 radiographically evaluated the performance of autologous platelet-rich plasma (PRP) applied in tooth sockets. Thirty extractions of bilateral impacted mandibular third molars were performed in 15 volunteers. After extraction of right and left mandibular third molars, the socket at one side received the autologous PRP (PRP group) and the other was filled with blood clot (control group). Millimeter periapical

radiographs were obtained 7 days, 1 month, and 2, 3, and 6 months postoperatively. There was significantly faster bone formation in sockets treated with PRP. Autologous PRP was found to accelerate alveolar bone regeneration, and men presented better repair after tooth extraction.

Materials and Methods

MATERIALS AND METHODS

The present study was conducted in the Department of Oral and Maxillofacial Surgery, Ragas Dental College and Hospital, Uthandi, Chennai. ASA I (All American Society of Anaesthesiologist classification I) patients who required removal of mesioangular impacted mandibular third molars, with Pell and Gregory classification class I or II and Position A or B were included in the study. Indication of impacted third molar removal resulted from prophylactic or orthodontic considerations. Medically compromised patients, pregnant patients, patients with acute pericoronitis were excluded from the study.

All the patients were explained about the procedure and informed consent was obtained from the patients. Ethical committee approval was obtained from our institution review board. Prior to third molar extraction, clinical and radiographic examination were done.

The patients were examined and a general medical history was taken, including smoking habits, menstrual cycle and use of oral contraceptives. The clinical examination was carried out on the general health of the patient, periodontal health of the lower second molar adjacent to the extraction site. Assessments were made regarding the oral hygiene standard, gingival condition and periodontal tissue breakdown in terms of increased probing depths and intra bony defects. Preoperative radiographic examination included

orthopantamogram and intraoral periapical radiograph. Assessments were made regarding the inclination of third molar, its state of eruption and contact relationship to adjacent second molar.

Baseline examination comprised the following variables.

1. Gingival margin to cementoenamel junction distance in relation to distal root of lower second molar
2. Probing depth in relation to distal root of lower second molar
3. Clinical attachment level in relation to distal root of lower second molar
4. Assessment of bone level in relation to distal root of lower second molar in a radiograph
5. Visual Analogue Scale for pain and sensitivity
6. Gingival index
7. Plaque index

Probing Depth: It is the distance from gingival margin to the bottom of the periodontal pocket

Clinical Attachment Level: It is the distance from cementoenamel junction to the bottom of the periodontal pocket

Bone Level: It is the distance from cementoenamel junction to the alveolar bone crest

All the sites were measured by the same examiner using William's periodontal probe and an average of measurements was calculated.

Surgical procedure:

Patients were prepared and draped. Using 2% lignocaine hydrochloride with adrenaline 1:80,000, inferior alveolar nerve block and long buccal nerve block was given. After obtaining anaesthesia the mouldable plastic cheek retractor was placed to prevent inadvertent damage to cheek mucosa and a mouth prop was placed. The patients were randomly allocated to any one of the flap designs namely Envelope, Wards or modified Ward's incision to expose the impacted mandibular third molar.

Envelope Incision: The incision starts on the ascending ramus, following the centre of the third molar shelf to the distobuccal surface of the second molar, and then extends as a sulcular incision to the mesiobuccal corner of the second molar. This flap is adequate for most mesial inclined and superficial impactions. This incision can be extended to the mesiobuccal surface of the first molar for better visibility and access.

Ward's Incision: Anterior vertical releasing incision curves forward from the distobuccal corner of the crown of the lower second molar and ends alongside the mesiobuccal cusp of that tooth. Crevicular incision is then extended distally level with the buccal side of the tooth to the external oblique ridge. If the anterior part of the flap is elevated from the bone one blade of a pair of

scissors may be inserted onto the surfaces of the bone and the incision completed by closing the blades. Posterior part of the incision must slope outwards as well as backwards, for the ascending ramus lies to the lateral side of the body of the mandible.

Modified Ward's incision: Anterior vertical releasing incision curves forward from the distobuccal corner of the crown of the lower first molar and ends alongside the mesiobuccal cusp of that tooth. Crevicular incision should be made through the buccal gingival crevice of the second molar. Incision is then extended distally level with the buccal side of the tooth to the external oblique ridge. If the anterior part of the flap is elevated from the bone, one blade of a pair of scissors may be inserted onto the surfaces of the bone and the incision completed by closing the blades. Posterior part of the incision must slope outward as well as backwards, for the ascending ramus lies to the lateral side of the body of the mandible.

Removal of bone and tooth:

After incision placement, Austin's retractor is used for flap reflection and lingual mucosa and lingual nerve is protected along with the linguo mucoperiosteum by Rugieme end of Howarth's elevator and held by chain of Meckesson's mouth prop. Bone guttering and tooth splitting was done using 703 bur with copious saline irrigation. Then the tooth luxated and elevated out of the socket using straight shank elevator. Sharp bony margins were smoothened using a Miller's bone file and socket curetted and irrigated using

saline and povidone iodine. Primary wound closure was done with 3-0 braided silk. Post operatively all the patients received Inj. Dexamethasone and Inj. Diclofenac sodium intramuscularly. Post operative instructions were given and patients were prescribed with a standard antibiotic regimen which consisted of Cap.Amoxycillin 500mg TDS, Tab.Metrogyl 400mg TDS, Tab.Brufen 400mg BD, Tab.Rantac 150mg BD for a period of 5 days. Suture removal was done after 7 days and reviewed postoperatively after 1 month, 2 months and 6 months.

PROFORMA

OP No: Age/Sex:

Name: Date:

Occupation: Religion:

Address: Income:

Chief complaints and Duration:

History of present illness:

Past medical history:

Hypertension

Asthma

Tuberculosis

Drug Allergy

Diabetes

Bleeding Disorders

Cardiovascular System

Anemia

Previous History

Presently Anemic ?

Others

Present Dental History:

Personal History:

Clinical Evaluation: Erupted / Partially Erupted / Non Erupted

Interpretation of Radiograph:

Classification:

Winter's: White Line

Amber Line

Red Line

Pell and Gregory's:

Class I	Class II	Class III
Position A	Position B	Position C

Position and Depth:

Root Pattern:

Shape of Crown:

Follicular Space:

Texture of Bone: Elastic Sclerotic

Inferior Alveolar Canal:

Second Molar: Root Pattern -

Distal Caries –

Difficulty Index:

Vertical – 1	Class I– 1	Position A– 1
Mesioangular –2	Class II–2	Position B– 2
Horizontal-3	Class III-3	Position C- 3
Distoangular-4		

3-5 – Not Difficult

6-7 – Moderate

8-10 – Very Difficult

Post Operative Medication:

FLAP DESIGN :

Distal root of II molar	PRE – OP		1 MONTH		2 MONTHS		6 MONTHS	
	DB	DL	DB	DL	DB	DL	DB L	D
Gingival margin to CEJ (mm)								
Probing Depth (mm)								
Clinical Attachment Level (mm)								

Bone Level (mm)	PRE –OP	6 MONTHS

VAS for PAIN :

	PRE - OP	1 MONTH	2 MONTHS	6 MONTHS
0				
1-3				
4-7				
8-10				

VAS for SENSITIVITY :

	PRE-OP	1 MONTH	2 MONTHS	6 MONTHS
0				
1-3				
4-7				
8-10				

PLAQUE INDEX:

PRE-OP 1 MONTH 2 MONTHS 6 MONTHS

Plaque index = + + + =

4

GINGIVAL INDEX:

PRE-OP 1 MONTH 2 MONTHS 6 MONTHS

Gingival Index = + + + =

4

Kugelberg Risk Index M3

Variable	Value
Preop Plaque Index	Not visible – 0 , visible – 1
Preop Probing Depth	$\leq$ 6mm – 0, > 6mm – 1
Preop Intrabony Defect	$\leq$ 3mm – 0, > 3mm – 1
Sagittal Inclination Third Molar	$\leq 50^0$ – 0, > 50^o – 1
Contact Area second and third molar	Small – 0 , large – 1
Resorption distal root of second molar	No – 0, Yes – 1
Pathological widening of follicle of third molar	No – 0, Mesial $\geq$ 2.5mm – 1
Smoking Habits	No – 0, Yes – 1

Risk Index M3	Index Score
No risk	$\leq$ 1
Low risk	2
Moderate risk	3
High risk	$\geq$ 4

Fig.1: ARMAMENTARIUM

Fig.2: PERIODONTAL PROBE

Fig.3: PERIODONTAL PROBE ON DISTOBUCCAL ASPECT OF SECOND MOLAR

Fig.4: PERIODONTAL PROBE ON DISTOLINGUAL ASPECT OF SECOND MOLAR

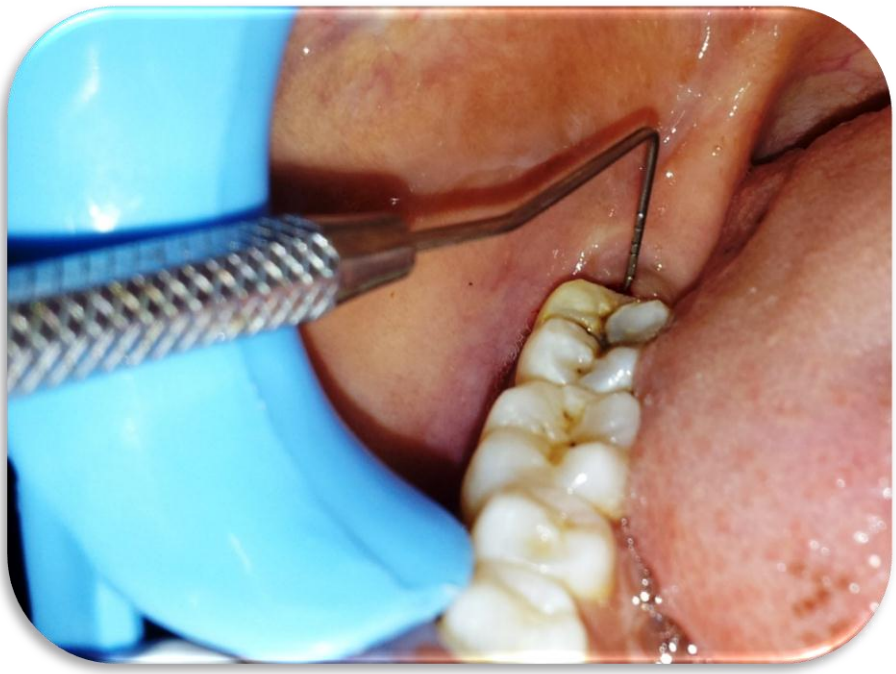


Fig.5: RADIOGRAPHIC ASSESSMENT

PRE-OPERATIVE

POST-OPERATIVE

Fig.6: ENVELOPE FLAP

PRE – OPERATIVE

INCISION LINE

EXPOSURE

TOOTH SOCKET

SUTURING

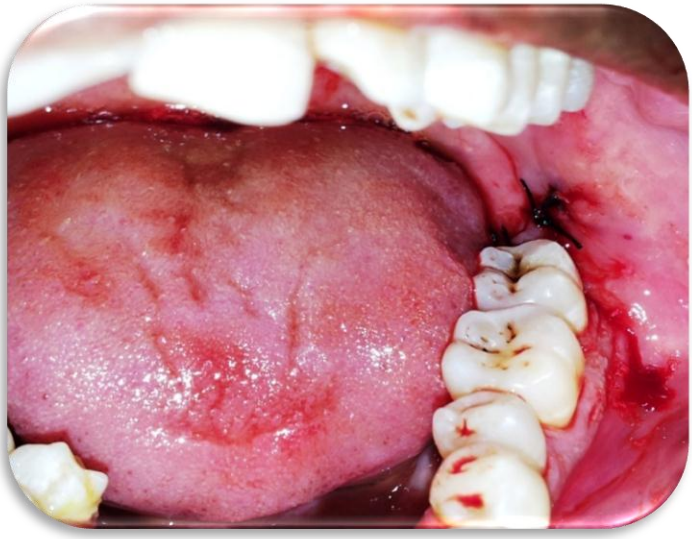
Fig.7: WARD'S FLAP

PRE-OPERATIVE

INCISION LINE

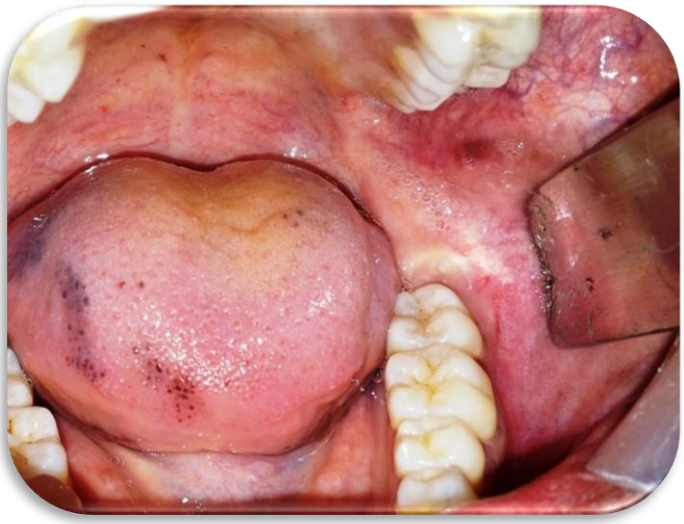
EXPOSURE

TOOTH SOCKET

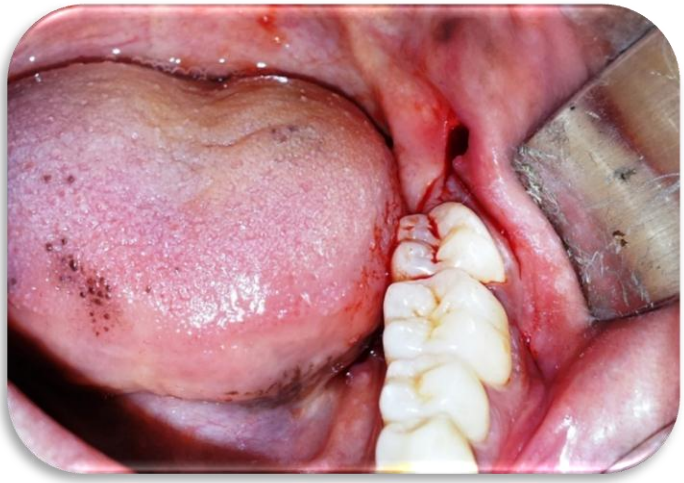


SUTURING

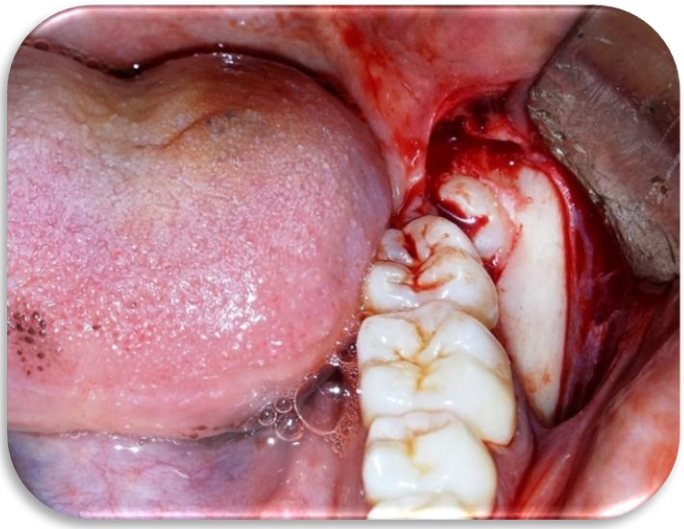
Fig.8: MODIFIED WARD'S FLAP



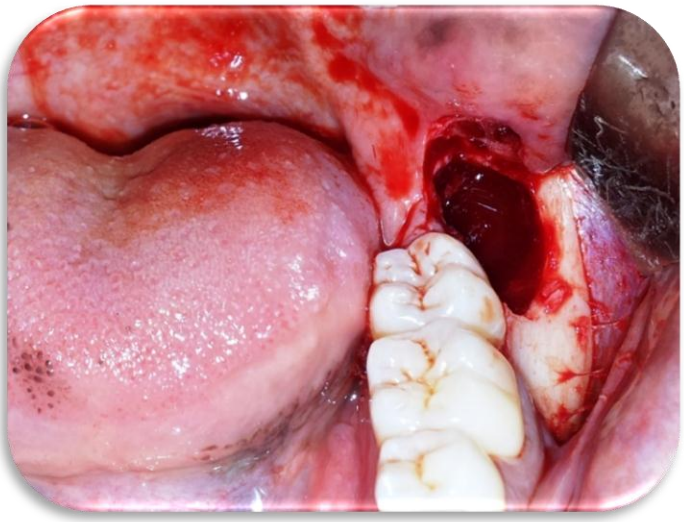
PRE-OPERATIVE



INCISION LINE



EXPOSURE



TOOTH SOCKET

SUTURING

Results

RESULTS

Descriptive statistics was done for all the groups at all the time points. Mann-Whitney test was used to compare the mean values between two groups at each time point. Wilcoxon Signed Ranks test was done to compare the mean values between two time points for all the three groups. These tests were done for age, sex, probing depth – distobuccal and distolingual, gingival margin to cementoenamel junction distance – distobuccal and distolingual, clinical attachment level – distobuccal and distolingual, bone level, plaque index, gingival index, VAS pain score, VAS sensitivity score.

The study population consisted of 30 patients, 14 males and 16 females. The age of the patients ranged from 18 to 45 years. Mean = 27.8 $\pm$ 8 years. The patients were randomly allotted to envelope, ward's or modified ward's incision group for the removal of impacted lower third molar. There was no statistically significant difference between the three groups based on age or gender (Table 1, table 2, table 3).

PROBING DEPTH:

Distobuccal:

The preoperative mean probing depth on the distobuccal surface of the mandibular second molar were 4.3 $\pm$ 0.7mm, 3.8 $\pm$ 1.2mm, 4.2 $\pm$ 1.2mm for the envelope, ward's and modified ward's incision respectively. There was no statistically significant difference between the three groups on preoperative

mean probing depth. All three groups showed an increase in probing depth at 1 month post operatively by about 0.6mm (Table 4). A statistically significant increase in mean probing depth at the end of one month was found for the envelope and wards incision (Table 6).

The probing depth was decreased for all three incision groups by about 0.4mm at 2 month post operatively when compared to the preoperative measurement. However the reduction in probing depth was not significant for ward's and modified ward's incision but was significant for the envelope incision.

At 6 months postoperative period, the mean probing depth decreased by 0.9mm, 0.5mm, 1.1 mm for the envelope, ward's and modified ward's incision respectively. At the end of 6 months there was a statistically significant reduction in mean probing depth for the envelope and modified ward's incision when compared to their respective pre operative measurements. But the reduction in probing depth was not statistically significant for the ward's incision when compared to its preoperative value. When the three flap designs were compared to each other there was no statistically significant difference between any groups at any point of time interval. (Table 4, Table 5).

Distolingual:

Table 7 shows the mean probing depth at the distolingual aspect of lower second molar increased about 0.4mm, 1.0mm, 0.7 mm one month post operatively for the envelope, wards and modified wards incision respectively. The probing depth decreased as the healing of the extracted third molar socket progresses. Six months post operatively there was a reduction of about 0.8mm, 0.5mm, 1.0mm for the envelope, wards and modified ward's incision respectively when compared to the pre operative mean probing depth measurements. Table 8 demonstrates that there was no statistically significant difference in the mean probing depth variation between the groups at any point of time namely 1, 2, 6 months duration.

Table 9 shows there was statistically significant increase in probing depth for the wards incision at 1 month post operative period when compared to the pre operative measurement. At two months post operatively all three groups showed decrease in probing depth but was not statistically significant. Statistically significant reduction in probing depth was found for the envelope and modified wards incision at 6 months post extraction period whereas for the wards incision the improvement in periodontal pocket was not statistically significant.

GINGIVAL MARGIN TO CEMENTOENAMEL JUNCTION:

Distobuccal:

The mean value between gingival margin to cement enamel junction on the distobuccal aspect of lower second molar were 2.0 $\pm$ 0.5 mm for envelope, ward's incision and the modified ward's incision (table10). There was no statistically significant difference in the preoperative measurement between the groups (table 11). One month post operatively the gingival margin to CEJ increased by 0.4mm, 0.1mm, 0.3mm for the envelope, wards and modified wards incision respectively. Two months post operatively the values returned to the pre operative measurements. At 6 months post operatively the values are same as that of preoperative measurements (2.1mm) for the envelope and modified incision where as Modified wards incision exhibited 0.2 mm less than the preoperative measurement. However the differences between the three groups were not statistically significant at any point of time (table 11). There was no statistically significant difference found between the preoperative and 6 months postoperative measurements (Table 12). When the three flap designs were compared to each other there was no statistically significant difference between any groups at any point of time interval.

Distolingual:

On the distolingual aspect of lower second molar the mean preoperative measurements were 2.0mm, 2.0mm and 1.9 mm for the envelope, wards and modified wards incision respectively. The values increased by 0.1mm for the envelope, wards incisions and by 0.4mm for the modified wards incision at 1 month post operatively. The values returned to the preoperative value at 2 months post operatively and stable even at 6 months post operative period. There was no statistically significant difference between the preoperative and 6 months post operative measurements. The difference between the three incision groups was also statistically insignificant at any points of time (Table 14, 15).

CLINICAL ATTACHMENT LEVEL:

Distobuccal:

The preoperative mean clinical attachment level on the distobuccal aspect of second molar were 2.2 $\pm$ 0.9mm, 1.8 $\pm$ 1.2mm, 2.1 $\pm$ 1.1mm for the envelope, wards and modified wards incision group respectively. The mean clinical attachment level one month post operatively were 2.6 $\pm$ 0.9mm, 2.3 $\pm$ 1.1mm, 2.3 $\pm$ 0.6mm which was slightly higher than the preoperative value indicating attachment loss during the immediate post operative period. 2 months post operatively the measurements decreased by 0.6mm, 0.2mm, 0.3mm for the envelope, wards and modified wards incision respectively. At 6 months postoperatively the measurements for all the three flap designs were lower than the preoperative level, indicating improvement in periodontal

health (table 16). There was statistically significant difference between preoperative and 6 month postoperative measurement for the envelope and modified wards group and not for the wards group (table 18). There was no statistically significant difference between any groups at any point of time interval when they were compared to each other (table 17).

Distolingual:

The preoperative mean clinical attachment level on the distolingual aspect of the lower second molar were 2.0 $\pm$ 1.2mm, 1.7 $\pm$ 1.2mm, 2.1 $\pm$ 1.2mm for the envelope, wards and modified wards incision group respectively. At 1 month postoperatively there was an increase of 0.3mm, 0.9mm, 0.3mm for the envelope, wards and modified wards incision group respectively (table 19). This increase was statistically significant for the wards incision and not for the other two flaps indicating attachment loss (table 21). At 2 months postoperatively the measurements returned to the baseline levels for all the three flaps. At 6 months postoperatively the measurements for all the three flap designs were lower than the preoperative level, indicating improvement in periodontal health. There was statistically significant difference between preoperative and 6 month postoperative measurement for the envelope and modified wards group and not the wards group (table 21). When the three flap designs were compared to each other there was no statistically significant difference between any groups at any point of time interval (table 20).

PLAQUE INDEX:

The preoperative mean plaque indices for the mandibular second molar were 1.2 ± 0.2, 1.1 ± 0.3, 1.2 ± 0.3 for the envelope, wards and modified wards incisions respectively. At 1 month postoperatively there was an increase in the plaque index for all the three flaps owing to decreased oral hygiene in the second molar region (table 22). This increase was statistically significant compared to preoperative values for all the three flap designs (table 24). At 2 months postoperatively the measurements returned to the baseline levels for all the three flaps. At 6 months postoperatively the plaque index was lower than the preoperative level for all the three flaps owing to better oral hygiene. There was statistically significant difference between preoperative and 6 month postoperative measurements for the modified wards incision group and not for the other two groups (table 24). When the three flap designs were compared to each other there was no statistically significant difference between any groups at any point of time interval (table 23).

GINGIVAL INDEX:

The preoperative mean gingival indices for the mandibular second molar were 1.18 ± 0.3, 1.05 ± 0.1, 1.1 ± 0.2 for the envelope, wards and modified wards incisions respectively. At 1 month postoperatively there was an increase in gingival index for all the three flap designs (table 25). This

increase was statistically significant compared to preoperative values for all the three flap designs (table 27). At 2 months postoperatively the measurements almost returned to the preoperative levels for all the three flap designs. At 6 months postoperatively the gingival index was lower than the preoperative level for all the three flaps. There was statistically significant difference between preoperative and 6 month postoperative measurements for the modified wards flap group and not for the other twp flap designs (table 27). There was no statistically significant difference between any groups at any point of time interval when compared (table 26).

BONE LEVEL:

The preoperative mean radiographic bone levels for the mandibular second molar were 4.6 $\pm$ 2.6mm, 3.8 $\pm$ 1.5 mm, 4.8 $\pm$ 2.5mm for the envelope, wards and modified wards incisions respectively. At 6 months postoperatively there was a decrease of 1.1mm, 0.9mm, 1.2mm for the envelope, wards and modified wards incisions respectively indicating a marked improvement in the periodontal status of the second molar (table 28). There was statistically significant difference between preoperative and 6 month postoperative measurements for the envelope and modified ward's flap groups and not for the ward's group. When the three flap designs were compared to each other there was no statistically significant difference between any groups at any point of time interval (table 29).

VAS PAIN SCORE:

The preoperative mean VAS pain scores for lower second molar were 2.2 $\pm$ 0.4, 1.9 $\pm$ 0.9, 2.2 $\pm$ 0.7 for the envelope, wards and modified wards incisions respectively. At 1 month postoperatively the scores for all the three flap designs were slightly lower than the preoperative values (table 31). The scores between the preoperative and 1 month postoperative values were statistically significant for modified wards flap group only (table 33). At 2 months postoperatively the scores dropped below the baseline levels and were statistically significant when compared to preoperative values for all the three flap designs. At 6 months postoperatively there was further reduction of the pain scores which were statistically significant when compared to preoperative values for all the three flap designs. There was no statistically significant difference between any groups at any point of time interval when compared (table 32).

VAS SENSITIVITY SCORE:

The preoperative mean sensitivity scores for lower second molar were 2.3 $\pm$ 0.4, 1.7 $\pm$ 0.6, 1.9 $\pm$ 0.3 for the envelope, wards and modified wards incisions respectively. At 1 month postoperatively the scores came down by 0.4 for the envelope flap group but remained at preoperative levels for wards and modified wards flap groups (table 34). The scores between the

preoperative and 1 month postoperative values were statistically significant for the envelope flap group only (table 36). At 2 months postoperatively the scores were lower than the preoperative levels and were statistically significant when compared to preoperative values for all the three flap designs. At 6 months postoperatively there was not much change in the sensitivity scores from the 2 months scores for all the three groups. But there was statistically significant difference between preoperative and 6 month postoperative measurements for all the three groups. When the three flap designs were compared to each other there was no statistically significant difference between any groups at any point of time interval (table 35).

Tables and Graphs

Table 1: Descriptive Statistics Age

Variable	Group	N	Mean	Std. Dev	Min	Max
Age (years)	Envelope	10	28.20	7.729	18	45
	Ward's	10	27.00	8.563	18	43
	M Ward's	10	28.20	8.651	19	43
	Total	30	27.80	8.053	18	45

Table 2: Mann-Whitney Test to compare the mean values between two groups

Variable	Groups	P-Value
Age	EnvelopevsWard's	0.761
	Envelopevs M Ward's	0.910
	Ward'svs M Ward's	0.622

Table 3: Sex Distribution

		Gender					
		Male		Female		Total	
		N	%	N	%	N	%
Group	Envelope	2	20.0	8	80.0	10	100.0
	Ward's	2	20.0	8	80.0	10	100.0
	M Ward's	10	100.0	0	0.0	10	100.0
	Total	14	46.7	16	53.3	30	100.0

Table 4: Descriptive Statistics Probing Depth – DB

Variable	Group	N	Mean	Std. Dev	Min	Max
PD-DB pre op	Envelope	10	4.30	0.675	3	5
	Ward's	10	3.80	1.229	3	7
	M Ward's	10	4.20	1.229	3	7
	Total	30	4.10	1.062	3	7
PD-DB 1month	Envelope	10	4.90	0.876	3	6
	Ward's	10	4.40	1.350	3	8
	M Ward's	10	4.70	0.823	4	6
	Total	30	4.67	1.028	3	8
PD-DB 2months	Envelope	10	3.70	0.483	3	4
	Ward's	10	3.60	0.966	3	6
	M Ward's	10	3.80	0.789	3	5
	Total	30	3.70	0.750	3	6
PD-DB 6months	Envelope	10	3.40	0.516	3	4
	Ward's	10	3.30	0.675	3	5
	M Ward's	10	3.10	0.568	2	4
	Total	30	3.27	0.583	2	5

Table 5: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
PD-DB pre op	0.058	0.492	0.293
PD-DB 1month	0.055	0.443	0.170
PD-DB 2months	0.327	0.865	0.408
PD-DB 6months	0.451	0.240	0.618

Table 6: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point (PD-DB)	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs1month	0.034	0.034	0.059
Pre op vs 2months	0.014	0.414	0.157
Pre op vs 6months	0.007	0.059	0.016
1month vs 2months	0.006	0.011	0.007
1month vs 6months	0.007	0.008	0.004
2months vs 6months	0.083	0.083	0.020

Table 7: Descriptive Statistics Probing Depth – DL

Variable	Group	N	Mean	Std. Dev	Min	Max
PD-DL pre op	Envelope	10	4.00	1.054	3	6
	Ward's	10	3.70	1.337	2	7
	M Ward's	10	4.00	1.333	2	6
	Total	30	3.90	1.213	2	7
PD-DL 1month	Envelope	10	4.40	1.075	3	6
	Ward's	10	4.70	1.160	3	7
	M Ward's	10	4.70	0.675	3	5
	Total	30	4.60	0.968	3	7
PD-DL 2months	Envelope	10	3.70	0.823	3	5
	Ward's	10	3.90	0.876	3	6
	M Ward's	10	3.60	0.843	2	5
	Total	30	3.73	0.828	2	6
PD-DL 6months	Envelope	10	3.20	0.422	3	4
	Ward's	10	3.20	0.632	3	5
	M Ward's	10	3.00	0.667	2	4
	Total	30	3.13	0.571	2	5

Table 8: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
PD-DL pre op	0.424	0.969	0.553
PD-DL1month	0.527	0.369	0.889
PD-DL 2months	0.593	0.935	0.585
PD-DL6months	0.626	0.453	0.619

Table 9: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point PD-DL	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.102	0.008	0.070
Pre op vs 2months	0.180	0.317	0.248
Pre op vs 6months	0.023	0.096	0.026
1month vs 2months	0.008	0.005	0.009
1month vs 6months	0.010	0.007	0.004
2months vs 6months	0.025	0.008	0.034

Table 10: Descriptive Statistics Gingival Margin – DB

Variable	Group	N	Mean	Std. Dev	Min	Max
GM-DB pre op	Envelope	10	2.00	0.471	1	3
	Ward's	10	2.00	0.000	2	2
	M Ward's	10	2.10	0.568	1	3
	Total	30	2.03	0.414	1	3
GM-DB 1month	Envelope	10	2.40	0.516	2	3
	Ward's	10	2.10	0.316	2	3
	M Ward's	10	2.40	0.699	2	4
	Total	30	2.30	0.535	2	4
GM-DB 2months	Envelope	10	2.10	0.316	2	3
	Ward's	10	2.00	0.000	2	2
	M Ward's	10	2.10	0.316	2	3
	Total	30	2.07	0.254	2	3
GM-DB 6months	Envelope	10	2.10	0.316	2	3
	Ward's	10	2.10	0.316	2	3
	M Ward's	10	1.80	0.422	1	2
	Total	30	2.00	0.371	1	3

Table 11: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
GM-DB pre op	0.999	0.654	0.543
GM-DB 1month	0.131	0.786	0.255
GM-DB 2months	0.317	0.999	0.317
GM-DB 6months	0.999	0.088	0.088

Table 12: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point GM-DB	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.046	0.317	0.083
Pre op vs 2months	0.317	0.999	0.999
Pre op vs 6months	0.317	0.317	0.180
1month vs 2months	0.083	0.317	0.180
1month vs 6months	0.083	0.999	0.034
2months vs 6months	0.999	0.317	0.083

Table 13: Descriptive Statistics Gingival Margin – DL

Variable	Group	N	Mean	Std. Dev	Min	Max
GM-DL pre op	Envelope	10	2.00	0.471	1	3
	Ward's	10	2.00	0.471	1	3
	M Ward's	10	1.90	0.316	1	2
	Total	30	1.97	0.414	1	3
GM-DL 1month	Envelope	10	2.10	0.316	2	3
	Ward's	10	2.10	0.568	1	3
	M Ward's	10	2.30	0.483	2	3
	Total	30	2.17	0.461	1	3
GM-DL 2months	Envelope	10	2.10	0.316	2	3
	Ward's	10	2.00	0.000	2	2
	M Ward's	10	1.90	0.316	1	2
	Total	30	2.00	0.263	1	3
GM-DL 6months	Envelope	10	2.10	0.316	2	3
	Ward's	10	2.00	0.000	2	2
	M Ward's	10	1.80	0.422	1	2
	Total	30	1.97	0.320	1	3

Table 14: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
GM-DL pre op	0.999	0.584	0.584
GM-DL 1month	0.957	0.276	0.423
GM-DL 2months	0.317	0.168	0.317
GM-DL 6months	0.317	0.088	0.146

Table 15: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point GM-DL	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.317	0.317	0.046
Pre op vs 2months	0.317	0.999	0.999
Pre op vs 6months	0.317	0.999	0.317
1month vs 2months	0.999	0.564	0.046
1month vs 6months	0.999	0.564	0.025
2months vs 6months	0.999	0.999	0.317

Table 16: Descriptive Statistics Clinical Attachment Level – DB

Variable	Group	N	Mean	Std. Dev	Min	Max
CAL-DB pre op	Envelope	10	2.20	0.919	1	4
	Ward's	10	1.80	1.229	1	5
	M Ward's	10	2.10	1.101	1	5
	Total	30	2.03	1.066	1	5
CAL-DB 1month	Envelope	10	2.60	0.966	1	4
	Ward's	10	2.30	1.059	1	5
	M Ward's	10	2.30	0.675	2	4
	Total	30	2.40	0.894	1	5
CAL-DB 2months	Envelope	10	1.60	0.516	1	2
	Ward's	10	1.60	0.966	1	4
	M Ward's	10	1.80	0.789	1	3
	Total	30	1.67	0.758	1	4
CAL-DB 6months	Envelope	10	1.30	0.483	1	2
	Ward's	10	1.20	0.632	1	3
	M Ward's	10	1.30	0.483	1	2
	Total	30	1.27	0.521	1	3

Table 17: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
CAL-DB pre op	0.168	0.577	0.251
CAL-DB 1month	0.318	0.367	0.728
CAL-DB 2months	0.551	0.615	0.408
CAL-DB 6months	0.357	0.999	0.357

Table 18: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point CAL-DB	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.046	0.059	0.317
Pre op vs 2months	0.034	0.414	0.257
Pre op vs 6months	0.014	0.034	0.020
1month vs 2months	0.015	0.008	0.059
1month vs 6months	0.006	0.005	0.004
2months vs 6months	0.083	0.046	0.059

Table 19: Descriptive Statistics Clinical Attachment Level – DL

Variable	Group	N	Mean	Std. Dev	Min	Max
CAL-DL pre op	Envelope	10	2.00	1.247	1	5
	Ward's	10	1.70	1.252	1	5
	M Ward's	10	2.10	1.197	1	4
	Total	30	1.93	1.202	1	5
CAL-DL 1month	Envelope	10	2.30	0.949	1	4
	Ward's	10	2.60	1.075	1	5
	M Ward's	10	2.40	0.699	1	3
	Total	30	2.43	0.898	1	5
CAL-DL 2months	Envelope	10	1.60	0.699	1	3
	Ward's	10	1.90	0.876	1	4
	M Ward's	10	1.70	0.675	1	3
	Total	30	1.73	0.740	1	4
CAL-DL 6months	Envelope	10	1.10	0.316	1	2
	Ward's	10	1.20	0.632	1	3
	M Ward's	10	1.20	0.422	1	2
	Total	30	1.17	0.461	1	3

Table 20: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
CAL-DL pre op	0.385	0.842	0.345
CAL-DL 1month	0.575	0.715	0.837
CAL-DL 2months	0.426	0.707	0.671
CAL-DL 6months	0.942	0.542	0.626

Table 21: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point CAL-DL	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.257	0.007	0.257
Pre op vs 2months	0.157	0.317	0.206
Pre op vs 6months	0.024	0.059	0.041
1month vs 2months	0.008	0.008	0.038
1month vs 6months	0.010	0.006	0.006
2months vs 6months	0.025	0.008	0.059

Table 22: Descriptive Statistics Plaque Index

Variable	Group	N	Mean	Std. Dev	Min	Max
PI pre op	Envelope	10	1.23	0.219	1.00	1.75
	Ward's	10	1.10	0.316	0.50	1.75
	M Ward's	10	1.25	0.312	1.00	2.00
	Total	30	1.19	0.284	0.50	2.00
PI 1month	Envelope	10	1.55	0.230	1.25	1.75
	Ward's	10	1.35	0.293	1.00	2.00
	M Ward's	10	1.48	0.184	1.25	1.75
	Total	30	1.46	0.246	1.00	2.00
PI 2months	Envelope	10	1.45	0.197	1.00	1.75
	Ward's	10	1.20	0.307	1.00	2.00
	M Ward's	10	1.15	0.269	0.75	1.50
	Total	30	1.27	0.286	0.75	2.00
PI 6months	Envelope	10	1.23	0.142	1.00	1.50
	Ward's	10	0.95	0.350	0.50	1.75
	M Ward's	10	0.80	0.158	0.50	1.00
	Total	30	0.99	0.290	0.50	1.75

Table 23: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
PI pre op	0.218	0.934	0.291
PI1month	0.084	0.400	0.162
PI 2months	0.013	0.016	0.775
PI6months	0.013	0.001	0.325

Table 24: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time Point PI	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.010	0.013	0.030
Pre op vs 2months	0.068	0.257	0.206
Pre op vs 6months	0.705	0.165	0.007
1month vs 2months	0.248	0.034	0.006
1month vs 6months	0.016	0.006	0.004
2months vs 6months	0.003	0.004	0.004

Table 25: Descriptive Statistics Gingival Index

Variable	Group	N	Mean	Std. Dev	Min	Max
GI pre op	Envelope	10	1.18	0.313	1.00	2.00
	Ward's	10	1.05	0.158	1.00	1.50
	M Ward's	10	1.10	0.211	1.00	1.50
	Total	30	1.11	0.234	1.00	2.00
GI 1month	Envelope	10	1.43	0.237	1.00	1.75
	Ward's	10	1.35	0.211	1.00	1.75
	M Ward's	10	1.33	0.121	1.25	1.50
	Total	30	1.37	0.194	1.00	1.75
GI 2months	Envelope	10	1.38	0.177	1.00	1.50
	Ward's	10	1.15	0.242	1.00	1.75
	M Ward's	10	1.18	0.265	0.75	1.50
	Total	30	1.23	0.245	0.75	1.75
GI 6months	Envelope	10	1.13	0.132	1.00	1.25
	Ward's	10	0.93	0.265	0.75	1.50
	M Ward's	10	0.78	0.249	0.50	1.25
	Total	30	0.94	0.260	0.50	1.50

Table 26: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
GI pre op	0.163	0.455	0.542
GI1month	0.423	0.230	0.795
GI 2months	0.019	0.076	0.744
GI6months	0.029	0.003	0.208

Table 27: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time Point GI	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.026	0.006	0.021
Pre op vs 2months	0.075	0.046	0.453
Pre op vs 6months	0.999	0.059	0.016
1month vs 2months	0.414	0.005	0.083
1month vs 6months	0.010	0.004	0.006
2months vs 6months	0.004	0.014	0.007

Table 28: Descriptive Statistics Bone Level

Variable	Group	N	Mean	Std. Dev	Min	Max
Bone Level pre op	Envelope	10	4.60	2.675	1	10
	Ward's	10	3.80	1.476	2	7
	M Ward's	10	4.80	2.486	2	10
	Total	30	4.40	2.238	1	10
Bone Level 6months	Envelope	10	3.50	1.716	1	7
	Ward's	10	2.90	1.449	2	6
	M Ward's	10	3.60	1.897	2	8
	Total	30	3.33	1.668	1	8

Table 29: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
BL pre op	0.551	0.816	0.388
BL6months	0.235	0.905	0.259

Table 30: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Variable	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 6months	0.026	0.087	0.014

Table 31: Descriptive Statistics VAS Pain score

Variable	Group	N	Mean	Std. Dev	Min	Max
VAS Pain pre op	Envelope	10	2.20	0.422	2	3
	Ward's	10	1.90	0.994	1	4
	M Ward's	10	2.20	0.789	1	4
	Total	30	2.10	0.759	1	4
VAS Pain 1month	Envelope	10	1.90	0.316	1	2
	Ward's	10	1.80	0.632	1	3
	M Ward's	10	2.00	0.471	1	3
	Total	30	1.90	0.481	1	3
VAS Pain 2months	Envelope	10	1.30	0.483	1	2
	Ward's	10	1.30	0.483	1	2
	M Ward's	10	1.30	0.483	1	2
	Total	30	1.30	0.466	1	2
VAS Pain 6months	Envelope	10	1.00	0.000	1	1
	Ward's	10	1.10	0.316	1	2
	M Ward's	10	1.20	0.422	1	2
	Total	30	1.10	0.305	1	2

Table 32: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
VAS Pain pre op	0.198	0.765	0.316
VAS Pain1month	0.582	0.584	0.399
VAS Pain 2months	0.999	0.999	0.999
VAS Pain6months	0.317	0.146	0.542

Table 33: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time Point VAS Pain	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.083	0.564	0.157
Pre op vs 2months	0.003	0.034	0.011
Pre op vs 6months	0.003	0.039	0.007
1month vs 2months	0.014	0.025	0.020
1month vs 6months	0.003	0.020	0.011
2months vs 6months	0.083	0.157	0.317

Table 34: Descriptive Statistics VAS Sensitivity score

Variable	Group	N	Mean	Std. Dev	Min	Max
VAS Sens pre op	Envelope	10	2.30	0.483	2	3
	Ward's	10	1.70	0.675	1	3
	M Ward's	10	1.90	0.316	1	2
	Total	30	1.97	0.556	1	3
VAS Sens 1month	Envelope	10	1.90	0.316	1	2
	Ward's	10	1.70	0.483	1	2
	M Ward's	10	1.90	0.316	1	2
	Total	30	1.83	0.379	1	2
VAS Sens 2months	Envelope	10	1.20	0.422	1	2
	Ward's	10	1.10	0.316	1	2
	M Ward's	10	1.20	0.422	1	2
	Total	30	1.17	0.379	1	2
VAS Sens 6months	Envelope	10	1.00	0.000	1	1
	Ward's	10	1.10	0.316	1	2
	M Ward's	10	1.30	0.675	1	3
	Total	30	1.13	0.434	1	3

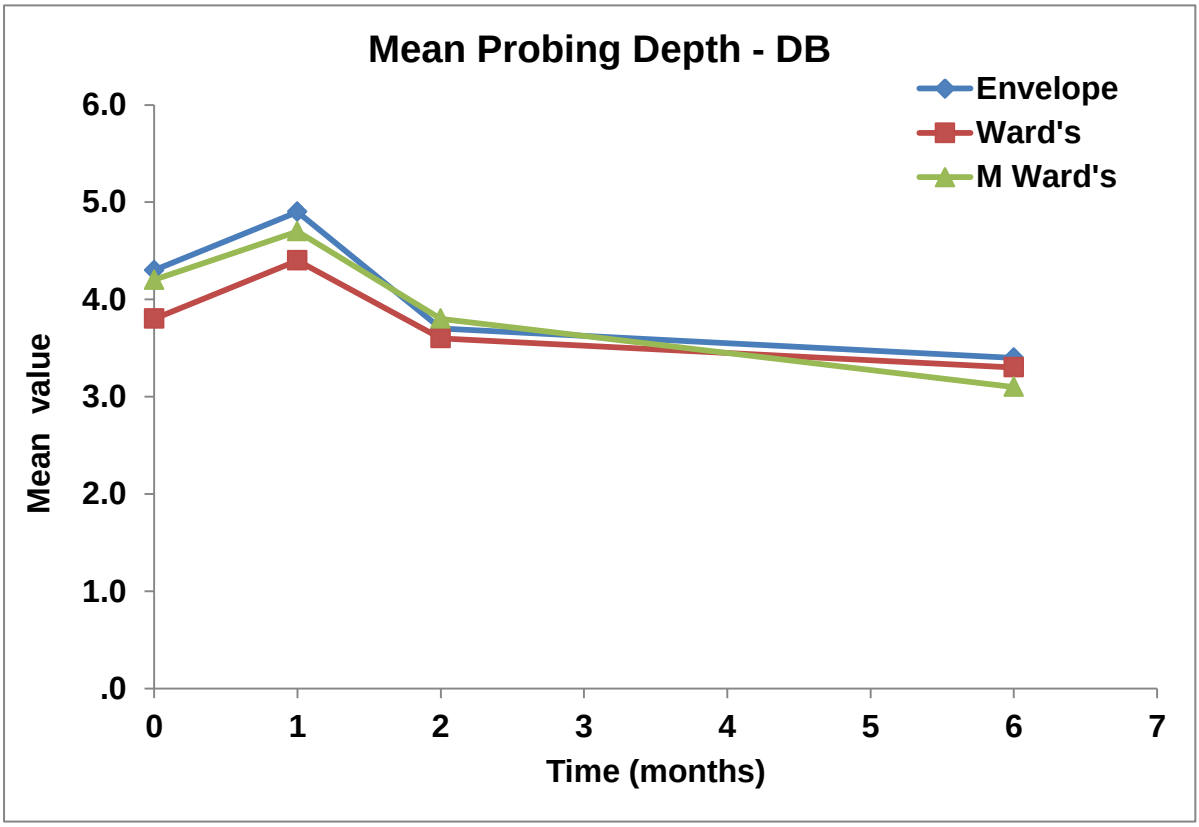
Table 35: Mann-Whitney Test to compare the mean values between two groups

Variable	P-Values		
	Envvs Ward's	Envvs M Ward's	Ward's vs M Ward's
VAS Sens pre op	0.039	0.045	0.322
VAS Sens1month	0.276	0.999	0.276
VAS Sens 2months	0.542	0.999	0.542
VAS Sens6months	0.317	0.147	0.503

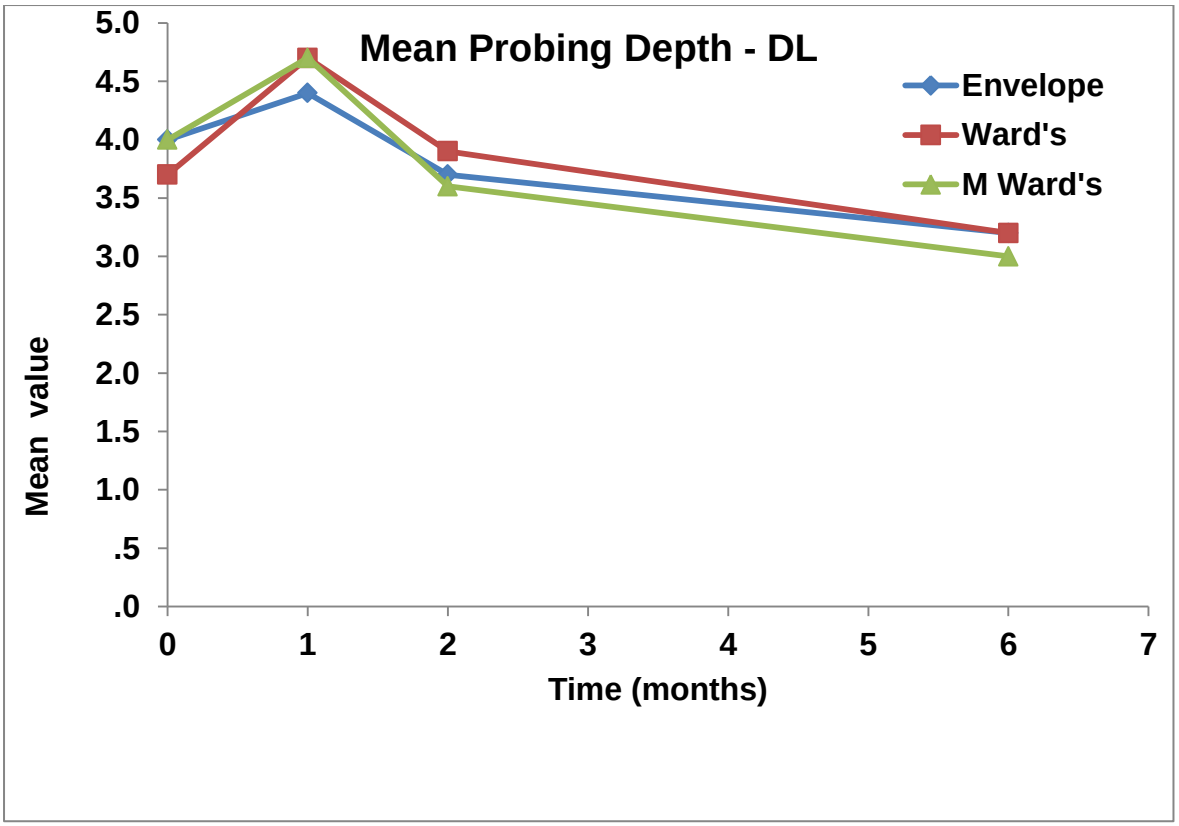
Table 36: Wilcoxon Signed Ranks Test to compare the mean values between two time points

Time point VAS Sens	P-Values		
	Envelope	Ward's	M Ward's
Pre op vs 1month	0.046	0.999	0.999
Pre op vs 2months	0.005	0.034	0.008
Pre op vs 6months	0.004	0.034	0.034
1month vs 2months	0.008	0.014	0.008
1month vs 6months	0.003	0.014	0.034
2months vs 6months	0.157	0.999	0.655

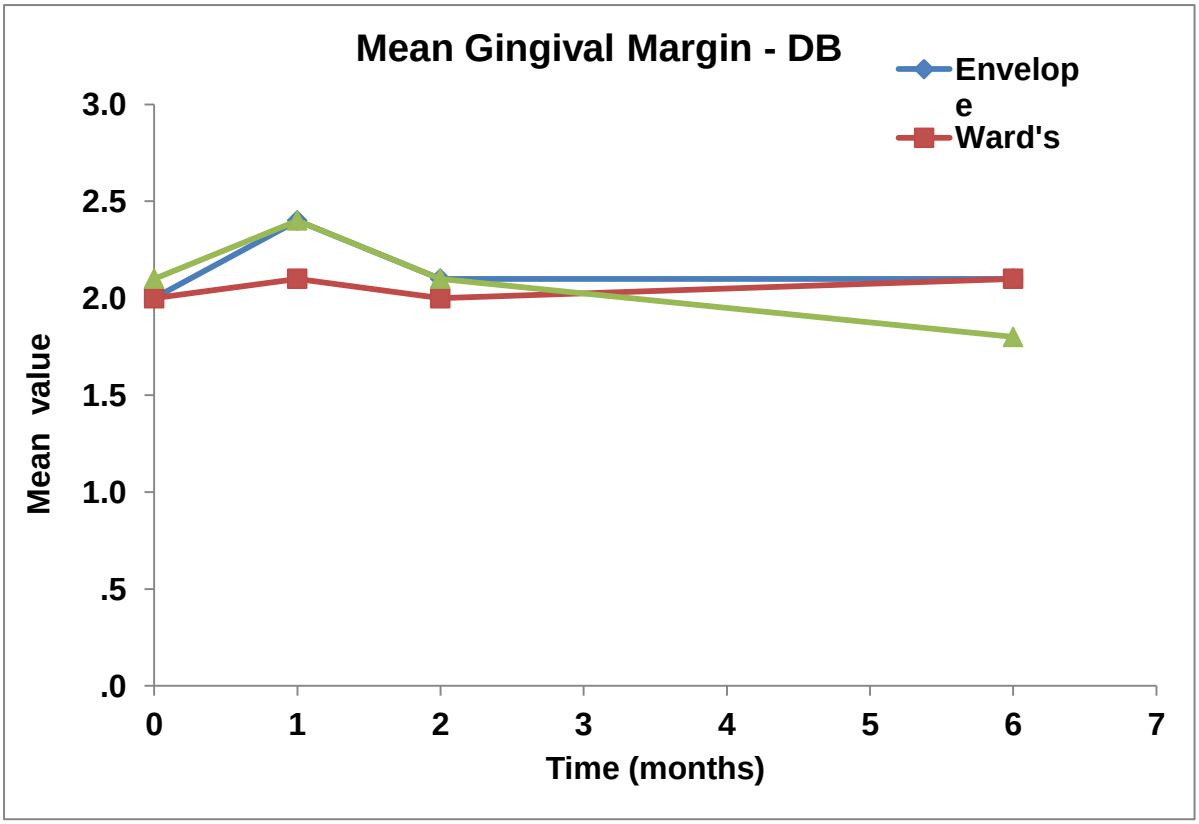
Graph 1: Denotes the mean Probing Depth – Distobuccal



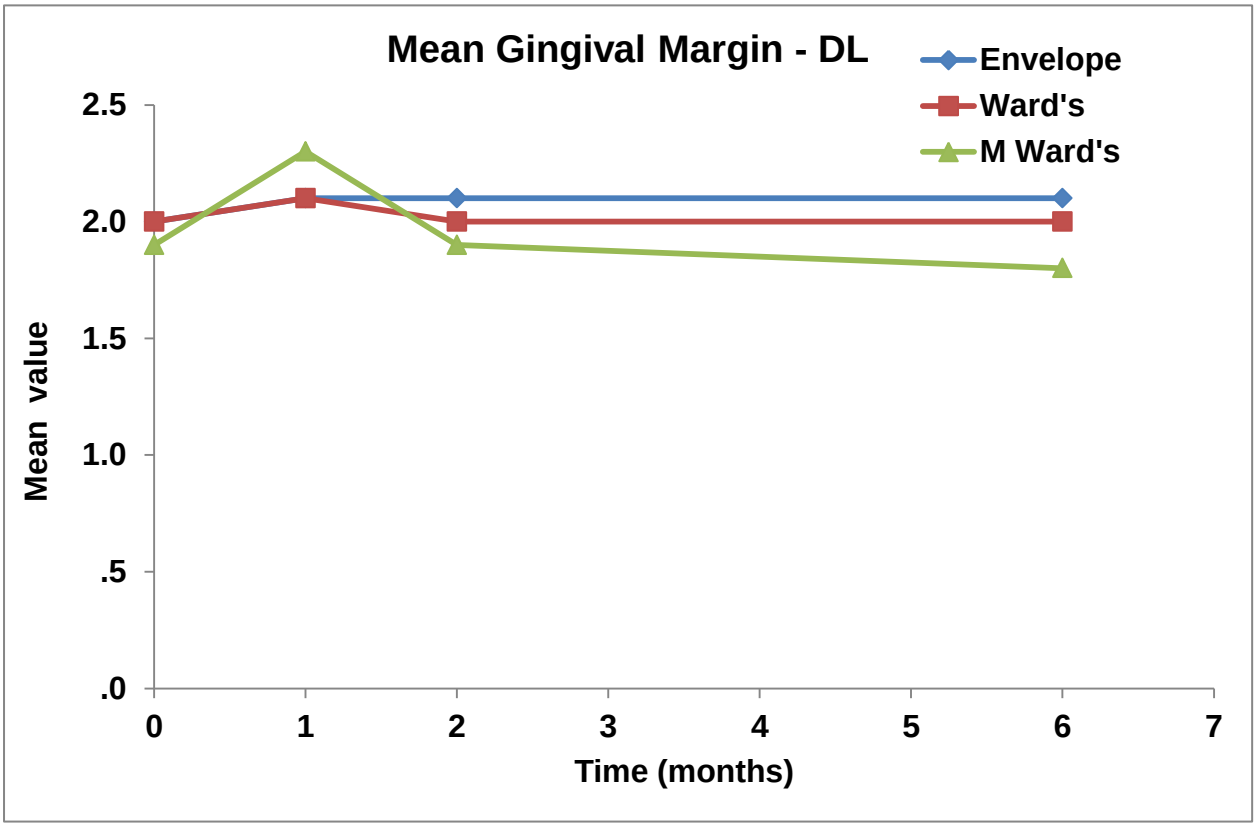
Graph 2: Denotes the mean Probing Depth – Distolingual



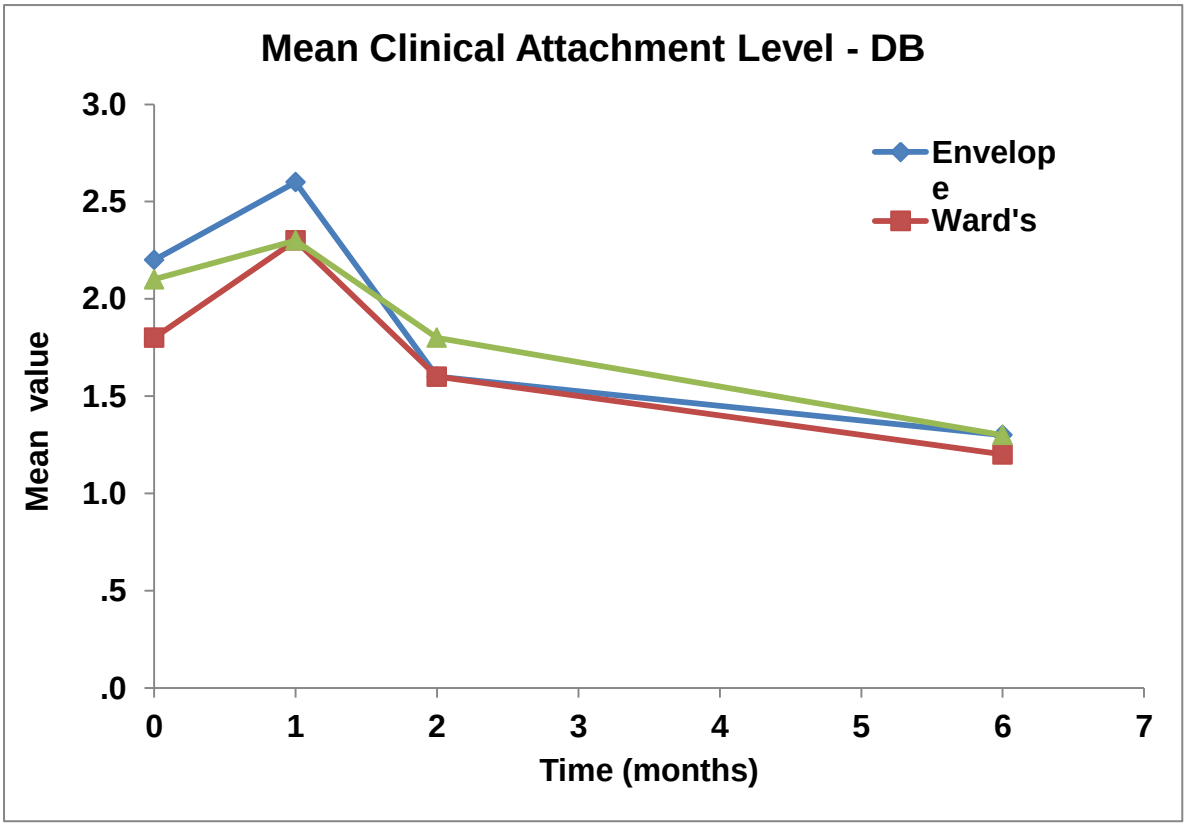
Graph 3: Denotes the mean Gingival Margin to CEJ – Distobuccal



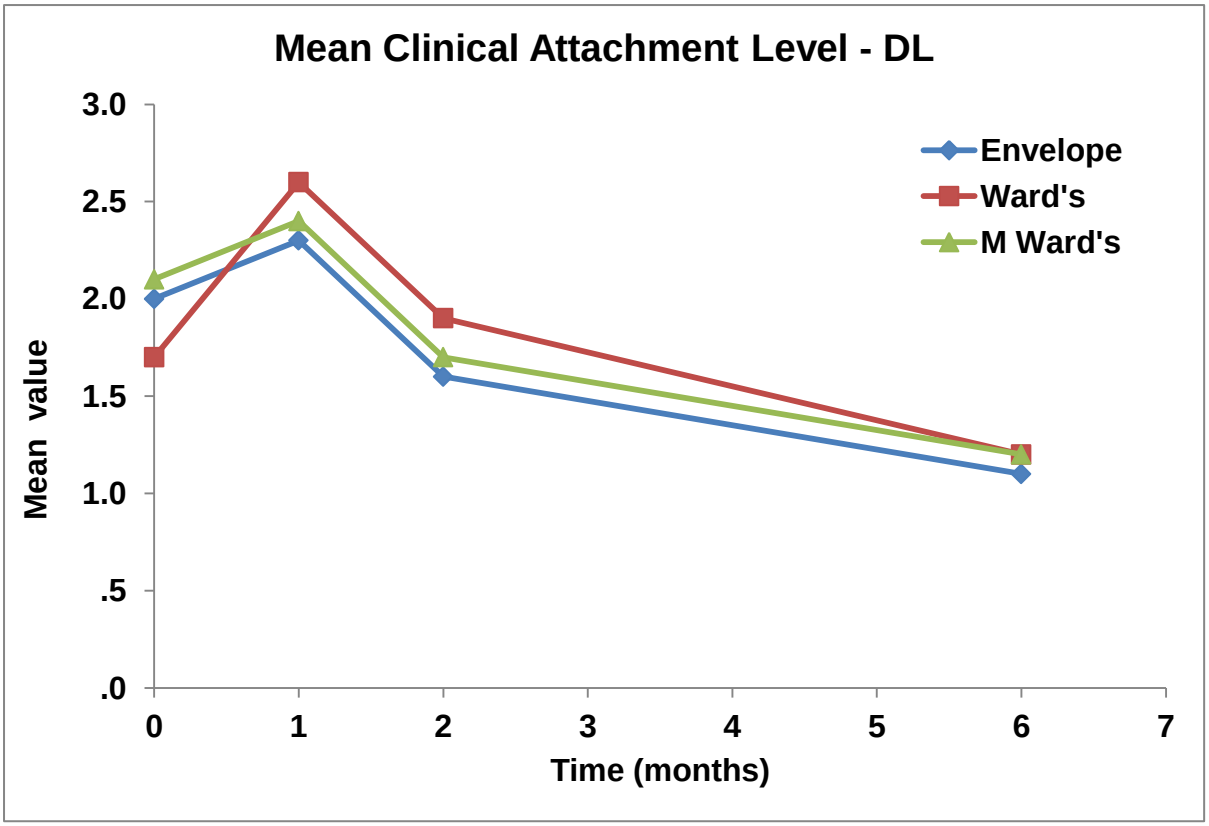
Graph 4: Denotes the mean Gingival Margin to CEJ – Distolingual



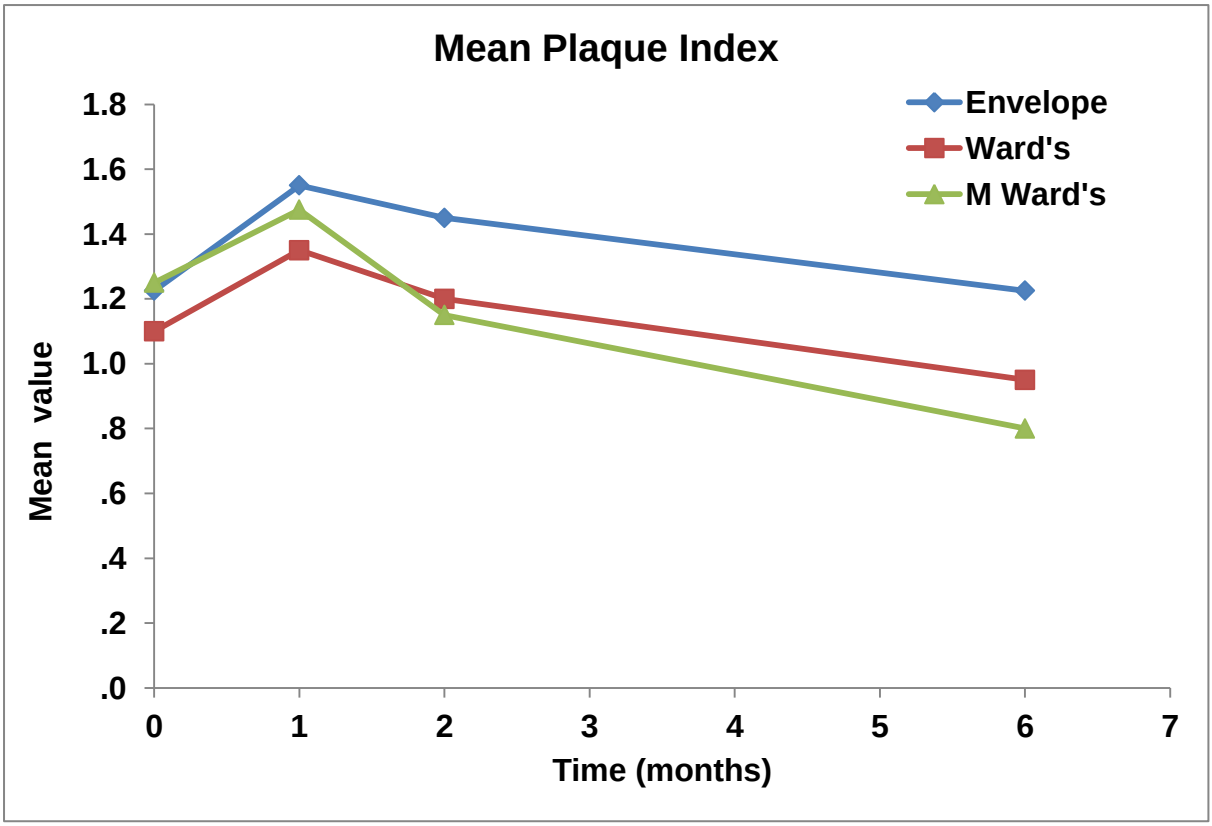
Graph 5: Denotes the mean Clinical Attachment Level – Distobuccal



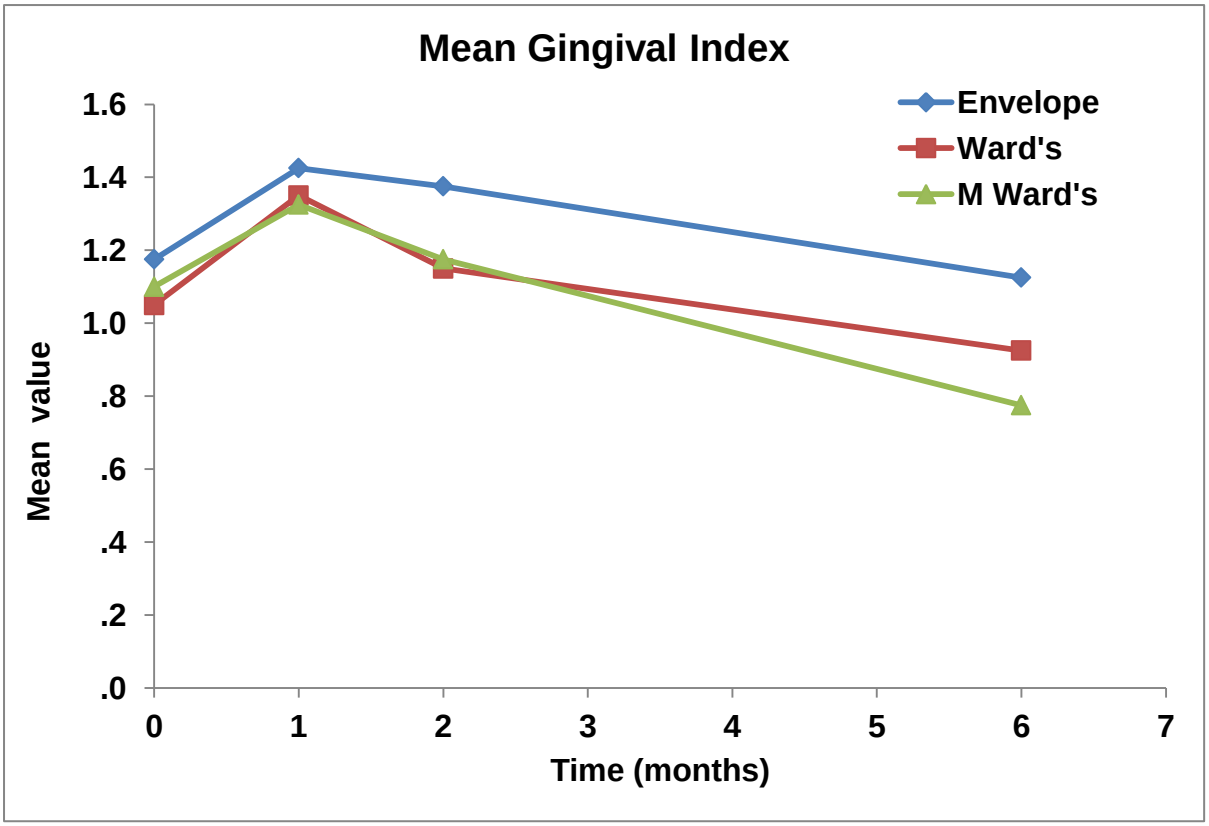
Graph 6: Denotes the mean Clinical Attachment Level – Distolingual



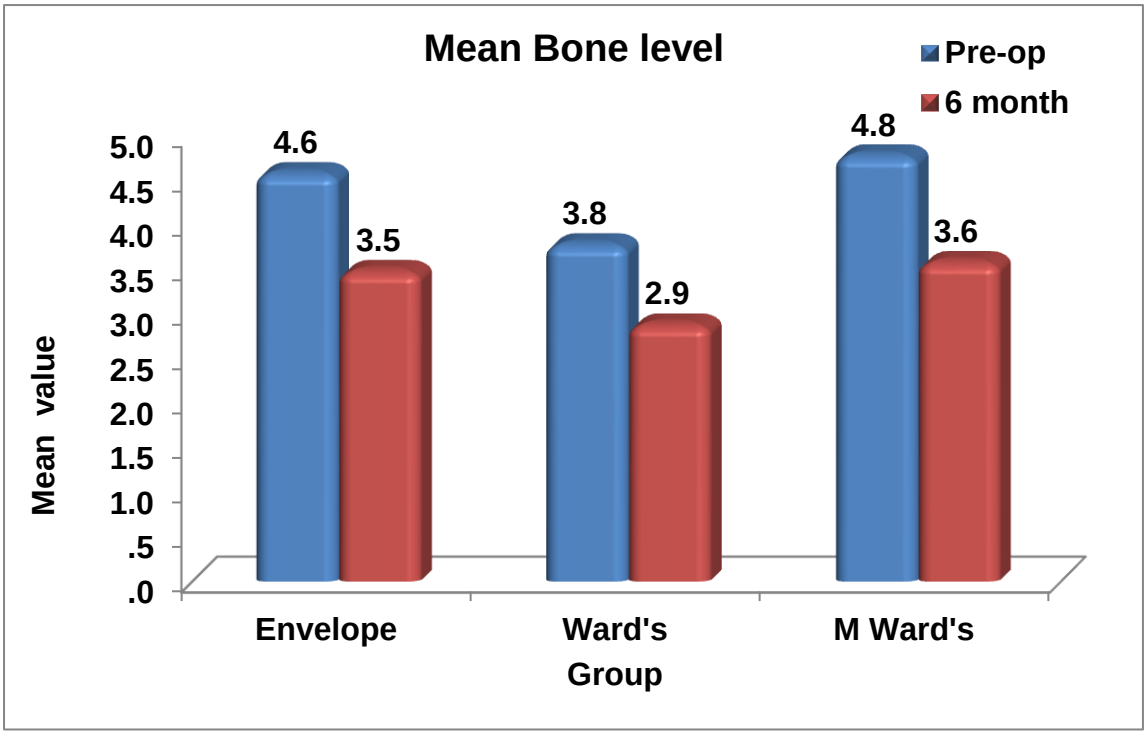
Graph 7: Denotes the mean Plaque Index



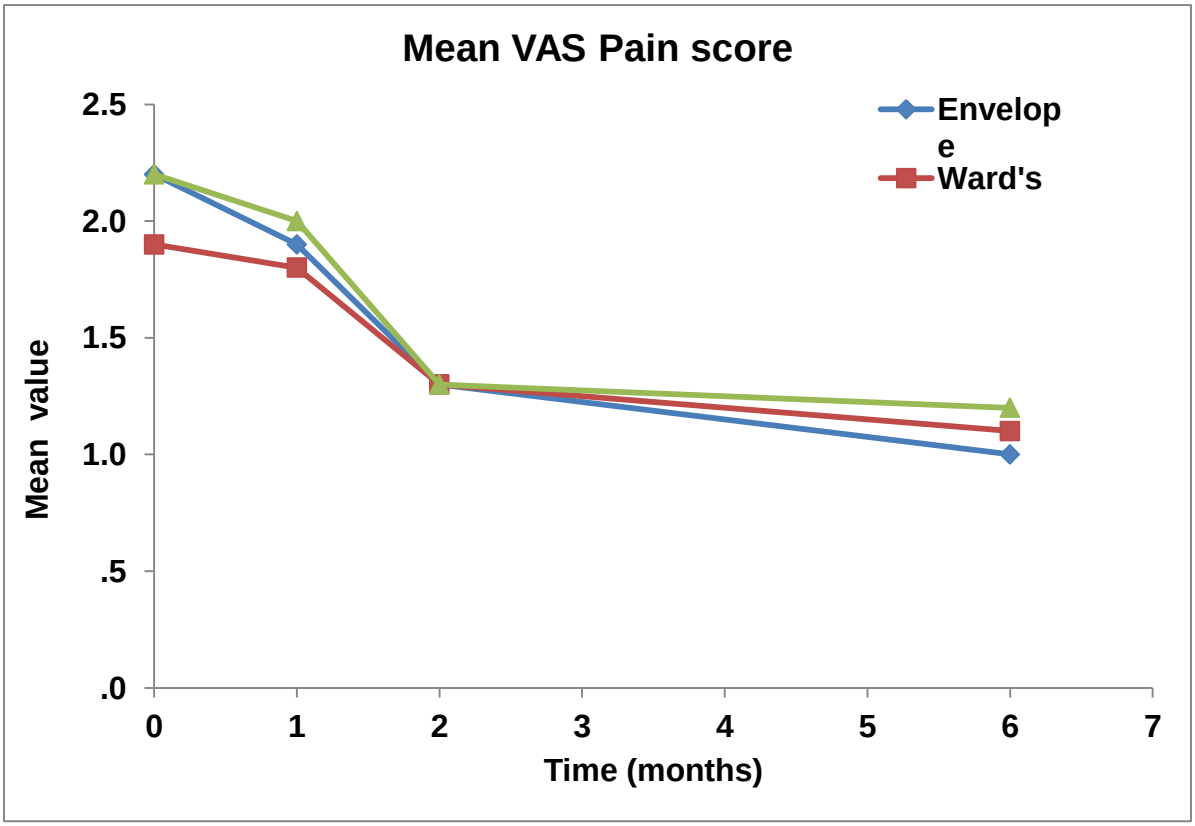
Graph 8: Denotes the mean Gingival Index



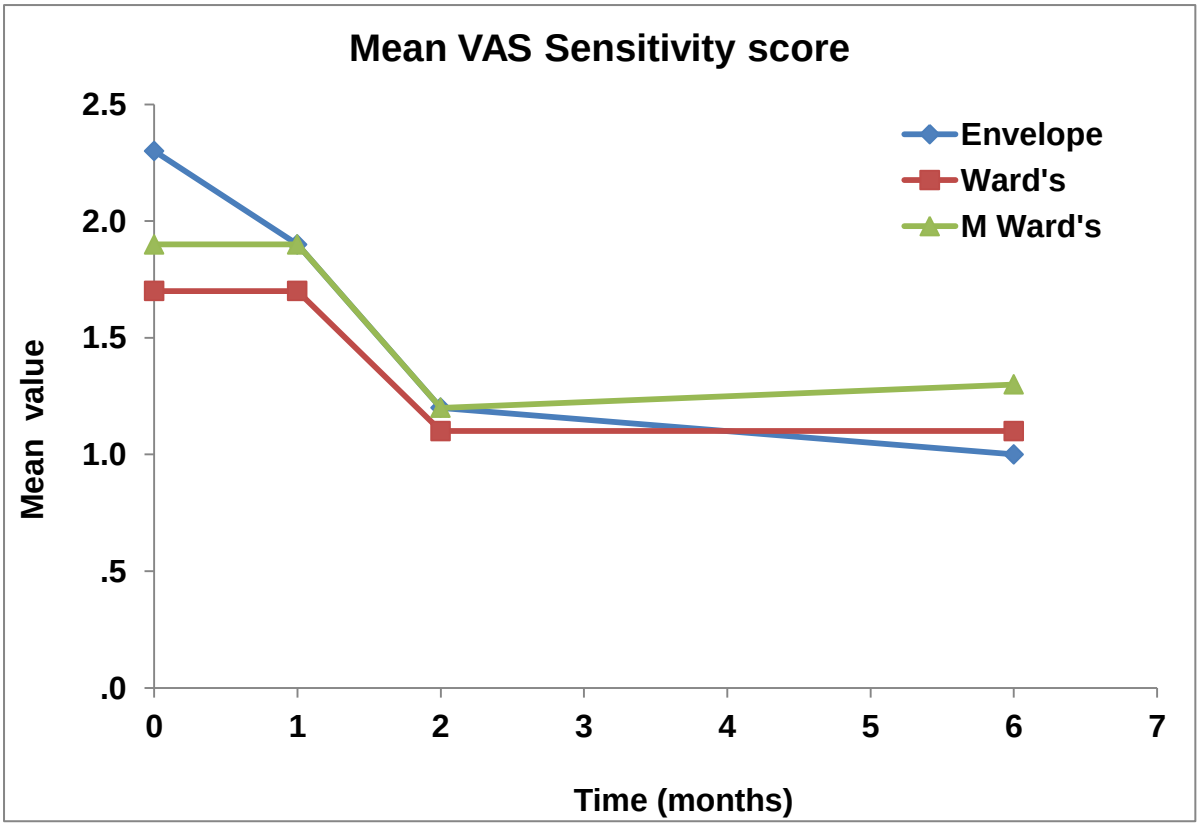
Graph 9: Denotes the mean Bone Level



Graph 10: Denotes the Mean VAS Pain Scale



Graph 11: Denotes the Mean VAS Sensitivity Scale



Discussion

DISCUSSION

The impacted lower third molar often leads to marginal periodontal complication involving both the second and third molar and causes periodontal pocketing and bone loss. Of all the posterior teeth the second molar next to an impacted lower third molar is highly prone to develop periodontal pathology because it favours food impaction, plaque accumulation and has very poor access for oral hygiene maintenance. Furthermore the tooth follicle around the impacted tooth is rich in osteoclasts which enhance bone resorption along with other factors.

Surgical removal of the impacted tooth also often complicates the periodontal health of the second molar. Displacement of attached gingival or the alveolar mucosa involves injury to the periosteum and the underlying bone. Thus the surface of bone is affected in several ways. Firstly, the cortical bone looses an important part of its vascular supply. Secondly, the cellular cover of bone provided by the innermost layer of periosteum is partially or totally removed. Thirdly, the surgical insult produced by the removal of bone with a surgical bur or chisel also complicates bone healing. These events invite an initial resorption of the bony surface, which however is then followed by bony deposition to repair the initial loss.[7]

Kugelberg et al[54] demonstrated that, 2 years after impacted lower third molar surgery 32.1% of the cases showed intra bony defect $\geq$ 4mm deep on the distal surface of the adjacent second molar. Jakse et al[43] have reported that dehiscence can take place distal to the second molar during primary wound healing after extraction of the impacted third molar and this area may heal secondarily.

In our study we used William's periodontal probe to assess the periodontal probing depth. Gingival pocket or pseudopocket is formed when the sulcus deepens because of the increased bulk of gingiva seen during inflammation. This happens in the presence of an impacted third molar. Whereas periodontal pocket occurs with the destruction of the supporting periodontal tissues.[16]To minimize the discrepancy we used more than one parameter to assess the periodontal health like clinical attachment level, gingival margin to CEJ, bone level from the CEJ. Measurements of bone level on pre and post operative radiographs are also taken for studying bone healing after impacted third molar surgery.

Rosa et al[73] reported that incidence of periodontal pocketing adjacent second molar increases following surgical removal of impacted tooth removal. But in our study, patients belonging to all three groups showed increased probing depth both on distobuccal and distolingual at one month post operatively. It may be attributed to the role of inflammation following the surgical removal of third

molar. As the socket healing progressed the inflammation subsided and all three groups showed a reduction in probing depth at 2 months and 6 months post operatively. The probing depth was the maximum for the wards incision. It may be due to the anterior releasing incision which often falls along the line of bone guttering and leads to wound dehiscence and secondary healing. At 6 months post operatively envelope and modified wards incision showed statistically significant reduction in probing depth indicating better periodontal health of the second molar. But the wards incision had a greater probing depth when compared to other flap designs. According to Kugelberg[54], the clinical diagnosis of marginal periodontal breakdown on the distal surface the second molar is apparent when the probing depth is 7mm or deeper.

Pocket formation causes loss of attachment of the gingiva and denudation of the root surface. The severity of the attachment loss is generally, but not always, correlated with the depth of the pocket. This is because the degree of attachment loss depends on the location of the base of the pocket on the root surface, whereas the pocket depth is the distance between the base of the pocket and the crest of the gingival margin. Pockets of the same depth may be associated with different degrees of attachment loss.[16]

Chin Quee et al[20] evaluated different flap designs and concluded that it resulted in significant loss of bone and loss of clinical attachment level on distal

aspect of second molar. None of our cases showed gingival recession on the distal surface of the second molar at the end of 6 months post operatively. Conversely clinical attachment level at 6 months post operatively was similar when compared to their respective preoperative assessment. The crestal bone regeneration has been found in all three group of cases after the removal of impacted third molar at 6 months post operatively. These improvements may be attributed that after removal of third molar there is less food impaction on the distal surface of the second molar and improved oral hygiene. There was no statistically significant difference found between the three groups in terms of clinical attachment level, gingival recession and alveolar crestal bone regeneration at 6 months post operatively.

Visual analogue scale indicated that none of the patients had experienced severe persisting pain or sensitivity at the end of one month. There was statistically significant improvement found in pain and sensitivity at 6 months post operatively. It is comparable to Schofield et al[78] study who has found that the effect of flap design on wound healing is only temporary and no significant difference were found on post operative periodontal health at 12 weeks post operatively.

In our study, younger patients had decreased periodontal defects and better healing. It is attributed to low osteogenic potential in adult individuals. In young

individuals, the periosteum consists of an inner layer of angular osteoblasts followed by spindle shaped precursor cells supported by loosely arranged collagen fibers. In older individuals, where growth has ceased, the inner layer consists of flattened osteoblasts followed by an outer fibrous layer of inactive osteoprogenitor cells, which however, still maintain their potential for cell division. When a periosteal flap is raised in adult patients, the osteogenic layer is usually disrupted and periosteal osteogenesis can only take place from the periphery of the wound where progenitor cells have not been disturbed, implying that bony repair will be limited and fibrous scar tissue will often form in its place. Conversely, in young individuals, cells in the cambium layer of elevated flaps exhibit osteogenic potential and the bone contour is often fully restored.[7]

The most common surgical injury to the alveolar bone complex is the extraction of teeth. Histologically, the healing of the socket consists following four overlapping stages namely coagulum, granulation tissue, connective tissue and bone formation. In man socket healing has been estimated indirectly, by analyzing serial radiographs taken of the extraction site. The first sign of healing is resorption of the lamina dura at the alveolar crest which can be seen after 2-4 weeks after extraction. Deeper in the alveolus, loss of lamina dura is usually apparent 4-8 weeks postoperatively. Complete healing of the socket is seen 6 months after extraction[24]. Hence in our study the bone levels were compared preoperatively and 6 months after surgery, after the completion of bone healing.

Risk factors associated with bone loss following lower third molar extraction included age, direction of eruption, preoperative bony defects, and resorption of the second molar root. All the patients had mesioangular impaction. From the findings of a series of clinical studies, an index predicting the risk of periodontal defects after impacted third molar surgery was designed by Kugelberg. Kugelberg Risk Index[7] was done for all the patients. Only two patients were of the high risk group, whereas the other subjects belonged to the low risk group.

The effect of flap design on the post operative periodontal health status of second molars was investigated with different flap designs. In our study, we assessed the periodontal health of the second molar in terms of probing depth, gingival attachment level, alveolar bone height and through oral hygiene index. We also assessed the primary healing and complications associated with the third molar removal with three different flap designs. We assessed the periodontal pocket depth and clinical attachment level using periodontal probe. The alveolar bone level was assessed clinically by periodontal probe and radiographically by standardized orthopantamogram.

In 2012, Goyal M et al[31] compared a conventional rotary handpiece and a Piezosurgical unit for extraction of lower third molars. A piezoelectric unit for surgical removal of impacted third molars reduced pain, swelling and trismus

considerably as compared to the conventional rotary handpiece. The use of piezoelectric handpiece for third molar surgery can be the future.

The extraction of mesioangular impacted third molars may cause multiple periodontal defects at the distal root of the second molar. Platelet-rich plasma (PRP) is a material containing many autologous growth factors that may be used in repairing and preventing periodontal complications at the distal root of the second molar adjacent to the extracted third molar.

Chen ZF[19] in 2011 investigated the effects of tissue engineered bone scaffold material in the restoration of alveolar socket after extraction of lower impacted third molar. Tissue engineered bone scaffold can be used in the restoration of alveolar socket after removal of impacted mandibular third molar.

The effectiveness of a therapeutic laser in the control of postoperative pain, swelling, and trismus associated with the surgical removal of impacted third molars was done by Amarillas-Escobar ED et al[4] in 2010. Use of therapeutic laser in impacted third molar surgery could be used widely in near future as it decreases postoperative pain, swelling and trismus.

Summary and Conclusion

SUMMARY AND CONCLUSION

In our study, independent of flap design, extraction of the impacted mandibular third molars resulted in a significant improvement in the periodontal health of adjacent second molars 6 months postoperatively in terms of probing depth, gingival margin level, clinical attachment level and alveolar crestal bone level. There was no statistically significant difference between the three flap designs.

There was no statistically significant difference between periodontal health status of the mandibular second molar before and after surgical removal of impacted third molar for all the three flap designs.

There was improvement in the periodontal health status of the mandibular second molar after surgical removal of impacted mandibular third molar for all the three flap designs.

Our patients were reviewed 1 week after surgical extraction of impacted third molar for suture removal and assessment of post operative complications. None of our patients had wound dehiscence or alveolar osteitis in the third molar region. The visual analogue scale indicated that none of the patients had experienced severe persisting pain or sensitivity at the end of one month.

Envelope flap is adequate for most mesially inclined and superficial impactions but the flap retraction was difficult. Envelope flap which is

designed without a releasing incision gave an inadequate access but yet covered the distal aspect of the adjacent second molar. Hence the periodontal status of the second molar was better in envelope flap after third molar surgery. This incision can also be extended to the mesiobuccal surface of the first molar. This modification allows for better access and visibility.

Ward's and Modified Ward's incisions have an oblique extension at the anterior aspect of the crestal incision. These incisions give better access and allow good flap retraction. Modified Ward's incision gives a better cover to the distal aspect of the second molar aiding its periodontal health after third molar surgery.

For a mesioangular impacted tooth, there was adequate alveolar bone on the distal surface of second molar when compared to a deep horizontal or a distoangular mandibular impacted tooth. Hence in our study, the flap design did not have much influence on the periodontal health of the second molar adjacent to a mesioangular impacted lower third molar.

As periodontal healing after surgical removal of impacted third molar is a continuing process even after 2 years, long term follow-up on clinical and radiographical parameters is required in order to further promote our understanding of how extraction of an impacted mandibular third molar affects the periodontal health of the adjacent second molar.

Bibliography

BIBLIOGRAPHY

1. ***Acham S, Klampfl A, Truschnegg A, Kirmeier R, Sandner-Kiesling A, Jakse N*:** Beneficial effect of methylprednisolone after mandibular third molar surgery – a randomized, double-blind, placebo-controlled split-mouth trial. Clin Oral Investig 30; 2012.
2. ***Albandar JM, Jostein R, Gjermo P, Johansen RJ:*** Radiographic quantification of alveolar bone level changes – a 2 year longitudinal study in man. J Clin Periodontol 13; 195-200, 1986.
3. ***Alonso MB, Costa PP, Issa JP, Monteiro SA, Tiossi R, Watanabe PC*:** Radiographical evaluation of bone quality after extraction of mandibular impacted and semi-impacted third molars. Minerva Stomatol 60(7-8); 359-364, 2011.
4. ***Amarillas-Escobar ED, Toranzo-Fernández JM, Martínez-Rider R, Noyola-Frías MA, Hidalgo-Hurtado JA, Serna VM, Gordillo-Moscoso A, Pozos-Guillén AJ*:** Use of therapeutic laser after surgical removal of impacted lower third molars. J Oral Maxillofac Surg 68(2); 319-324, 2010.
5. ***Ana FI, Mercedes GT*:** A modified device for intraoral radiography to assess the distal osseous defects of mandibular second molar after impacted third molar surgery. Imaging Sci Dent 41(3), 115-121, 2011.

6. ***Ana IF, Mercedes GT, Monica LR*:** Mandibular second molar periodontal healing after impacted third molar extraction in young adults. J Oral Maxillofac surg 70(12); 2732-2741, 2012.
7. ***Andreasen JO, Petersen JK, Laskin DM:*** Textbook and color atlas of tooth impactions.
8. ***Anil KD, Murali KT, Vinod N, Avinash S*:** Influence of primary and secondary closure of surgical wound after impacted mandibular third molar removal on postoperative pain and swelling – A comparative and split mouth study. J Oral Maxillofac Surg 68(2); 309-312, 2010.
9. ***Ash M.M, Jr Costitch ER and Hayward JR* :** Study of periodontal hazards of third molars. J Periodontal 33; 209, 1962.
10. ***Aznar-Arasa, K Harutunian, R Fiqueiredo, E Valmaseda C, C. Gay Escoda*:** Effect of preoperative ibuprofen on pain and swelling after lower third molar removal – a randomized controlled trial. Int J Oral Maxillofac Surg 41(8); 1005-1009, 2012.
11. ***Baqain ZH, A.Al-Shafii, A.A.Hamdan, F.A.Sawair*:** Flap design and mandibular third molar surgery – a split mouth randomized clinical study. Int J Oral Maxillofac Surg 41(8); 1020-1024, 2012.
12. ***Briguglio F, Zenobio EG, Isola G, Briguglio R, Briguglio E, Farronato D, Shibli JA*:** Complications in surgical removal of impacted mandibular third molars in relation to flap design - clinical and statistical evaluations. Quintessence Int 42(6); 445-453, 2011.

13. ***Bruce RA, Frederickson GC, Small GS*****:** Age of patient and morbidity associated with mandibular third molar surgery. J American Dental Association (JADA) 101; 240-245, 1980.
14. ***Carolyn D, George H.B, Jan FE, Eric H, Steven O, Ceib P, Raymond PW*****:** Second molar periodontal inflammatory disease after third molar removal in young adults. J Oral Maxillofac Surg 68; 3000-3006, 2010.
15. ***Carolina L, Berta G, Maria P, Miquel P*****:** Influence of oral hygiene and smoking on pain and swelling after surgical extraction of impacted mandibular third molars. J Oral Maxillofac Surg 68(1); 43-46, 2010.
16. ***Carranza FA, Newmann MG, Takei HH, Klokkevold PR*****:** Clinical Periodontology. 2007.
17. ***Célio-Mariano R, de Melo WM, Carneiro-Avelino C*****:** Comparative radiographic evaluation of alveolar bone healing associated with autologous platelet-rich plasma after impacted mandibular third molar surgery. J Oral Maxillofac Surg 70(1); 19-24, 2012.
18. ***Chang HH, Lee JJ, Kok SH, Yang PJ*****:** Periodontal healing after mandibular third molar surgery – a comparison of distolingual alveolectomy and tooth division techniques. Int J Oral Maxillofac Surg 33(1); 32-37, 2004.
19. ***Chen ZF*****:** Tissue engineered bone scaffold material in restoration of alveolar socket after extraction of lower impacted third molar. Shanghai Kou Qiang Yi Xue 20(1); 93-96, 2011.

20. ***Chin Quee TA, Gosselin D, Millar EP, Stamm JW*****:** Surgical removal of the fully impacted mandibular third molar. The influence of flap design and alveolar bone height on the periodontal status of the second molar. J Periodontal 625-630, 1984.
21. ***Clauster C, Barone R*****:** Effects of incision and flap reflection on postoperative pain after removal of partially impacted mandibular third molars. Quintessence Int 25; 845-849, 1994.
22. ***Coll AM, Ameen JR, Mead D*****:** Postoperative pain assessment tools in day surgery – literature review. J Advanced Nursing 46(2); 124-133, 2004.
23. ***Corinaldesi G, Lizio G, Badiali G, Morselli-Labate AM, Marchetti C*****:** Treatment of intrabony defects after impacted mandibular third molar removal with bioabsorbable and non-resorbable membranes. J Periodontol 82(10); 1404-1413, 2011.
24. ***Dalitz GD*****:** A radiographic study of the rate at which human extraction wounds heal. Aust Dent J 9; 466-473, 1964.
25. ***Dolanmaz D, Esen A, Isik K, Candirli C*****:** Effect of 2 flap designs on postoperative pain and swelling after impacted third molar surgery. Oral Surg Oral Med Oral Pathol Oral Radiol 20, 2012.
26. ***Erdogan O, Tatlı U, Ustün Y, Damlar I*****:** Influence of two different flap designs on the sequelae of mandibular third molar surgery. Oral Maxillofac Surg 15(3); 147-152, 2011.

27. ***Fabio Ricardo LS, Luciana A, Denis Emanuel SA, Marcio dM*:** Short-term outcome of postoperative patient recovery perception after surgical removal of third molars. J Oral Maxillofac Surg 67(5); 1083-1091, 2009.
28. ***George H.B, David W.P, Donald J.H, Raymond P.W, Steven O, Ceib P*:** Impact of removal of asymptomatic third molars on periodontal pathology. J Oral Maxillofac Surg 67; 245-250, 2009.
29. ***Giuseppe M, Giuseppe D, Loredana T, Giuseppe C, Claudio M*:** Mandibular third molar removal in young patients: An evaluation of 2 different flap designs. J Oral Maxillofac Surg 67; 15-21, 2009.
30. ***Gool AVV, Bosh JJT, Boering G*:** Clinical consequences of complaints and complications after removal of mandibular third molar. Int J Oral Surg 6; 29-37, 1977.
31. ***Goyal M, Marya K, Jhamb A, Chawla S, Sonoo PR, Singh V, Aggarwal A*:** Comparative evaluation of surgical outcome after removal of impacted mandibular third molars using a Piezotome or a conventional handpiece - a prospective study. Br J Oral Maxillofac Surg 50(6); 556-561, 2012.
32. ***Grondahl HG, Lekholm U*:** Influence of mandibular third molars on related supporting tissues. Int J Oral Surg 2; 137-142, 1973.
33. ***Grooves B.T and Moore T.R* :** The periodontal implications of flap designs in lower third molar extractions. Dent Pract. Dent. Res 20; 297, 1970.

34. ***Gupta S, Bhowate RR, Nigam N, Saxena S*****:** Evaluation of impacted mandibular third molars by panoramic radiography. ISRN Dent 2011.
35. ***Guralnick W:*** Third molar surgery. Br. Dent. J 156; 389, 1984.
36. ***Haffajee AD, Socransky SS, Goodson JM*****:** Clinical parameters as predictors of destructive periodontal disease activity. J Clin Periodontology 10; 257-265, 1983.
37. ***Haraji A, Motamedi MH, Rezvani F*****:** Can flap design influence the incidence of alveolar osteitis following removal of impacted mandibular third molars? Gen Dent 58(5); e187-e189, 2010.
38. ***Hashemi HM, Beshkar M, Aghajani R*****:** The effect of sutureless wound closure on postoperative pain and swelling after impacted mandibular third molar surgery. Br J Oral Maxillofac Surg 50(3); 256-258, 2012.
39. ***Hassan KS, Marei HF, Alagl AS*****:** Composite bone graft for treatment of osseous defects after surgical removal of impacted third and second molars - case report and review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 112(6); e8-e15, 2011.
40. ***Hassan KS, Marei HF, Alagl AS*****:** Does grafting of third molar extraction sockets enhance periodontal measures in 30-35 year old patients? J Oral Maxillofac Surg 70(4); 757-764, 2012.
41. ***Hausmann E, Raisz LG, Miller WA*****:** Endotoxin – stimulation of bone resorption in tissue culture. Science 168; 862-864, 1970.

42. ***Hazza'a AM, Bataineh AB, Odat AA*:** Angulation of mandibular third molars as a predictive factor for pericoronitis. J Contemp Dent Pract 10(3); 51-58, 2009.
43. ***Jakse N, Bankaoglu V, Wimmer G*:** Primary wound healing after lower third molar surgery. Evaluation of two different flap designs. Oral Med Oral Pathol Oral Radiol Endod 93; 7, 2002.
44. ***Javier Montero, Giuseppe Mazzaglia*:** Effect of removing an impacted mandibular third molar on the periodontal status of the mandibular second molar. J Oral Maxillofac Surg 69(11); 2691-2697, 2011.
45. ***Jose L Lopez-Cedrun, Jose IP, Susana F, Joseba S, Gonzalo H*:** Efficacy of amoxicillin treatment in preventing postoperative complications in patients undergoing third molar surgery – A prospective, randomized, double-blind controlled study. J Oral Maxillofac Surg 69(6); e5-e14, 2011.
46. ***Kaminishi R.M, Howard.W, Davis and Nina E. Nelson*:** Surgical removal of impacted mandibular molar. Dent. Clin. North Am 23; 3, 1979.
47. ***Kan KW, Liu JKS. Lo ECM, Corbert EF, Leung WK*:** Residual periodontal defects distal to the mandibular second molar 6-36 months after impacted third molar extraction. A retrospective cross-sectional study of young adults. J Clin Periodontol 29; 1004-1101, 2002.

48. ***Karaca Nci*:** Review of flap design influence on the health of the periodontium after mandibular third molar surgery. Jr Oral Surg Oral Med Oral Pathol Oral Radiol Endod 104; 18-23, 2007.
49. ***Khande K, Saluja H, Mahindra U*:** Primary and secondary closure of the surgical wound after removal of impacted mandibular third molars. J Maxillofac Oral Surg 10(2); 112-117, 2011.
50. ***Kirtiloglu T, Emel B, Mahmut S, Inanc C*:** Comparison of 2 flap designs in the periodontal healing of second molars after fully impacted mandibular third molar extractions. J Oral Maxillofac Surg 65; 2206-2210, 2007.
51. ***Koyuncu BO, Cetingul E*:** Short term clinical outcomes of two different flap techniques in impacted mandibular third molar surgery. Oral Surg Oral Med Oral Pathol Oral Radiol 23; 2012.
52. ***Krausz AA, Machtei EE, Peled M*:** Effects of lower third molar extraction on attachment level and alveolar bone height of the adjacent second molar. Int J Oral Maxillofac Surg 34; 756-760, 2005.
53. ***Kugelberg CF:*** Impacted lower third molars and periodontal health. An epidemiological, methodological retrospective and prospective clinical study. Swed Dent J 68; 1990.
54. ***Kugelberg CF, Ahlstorm U, Ericson S, Hugoson A:*** Periodontal healing after impacted lower third molar surgery – Precision and accuracy of radiographic assessment of intrabony defects. Int J Oral Maxillofac Surg 15; 675-686, 1986.

55. ***Kugelberg CF, Ahlstorm U, Ericson S, Hugoson A, S. Kvint*:** Periodontal healing after impacted lower third molar surgery. A retrospective study. Int J Oral Surg 14(1); 29-40, 1985.
56. ***Kugelberg CF, Ahlstorm U, Ericson S, Hugoson A, S. Kvint:*** Periodontal healing two and four years after impacted lower third molar surgery – a comparative retrospective study. Int J Oral Maxillofac Surg 19; 341-345, 1990.
57. ***Kugelberg CF, Ahlstorm U, Ericson S, Hugoson A, S. Kvint*:** Periodontal healing after impacted lower third molar surgery in adolescence and adults. Int J Oral Surg 20; 18-24, 1991.
58. ***Kugelberg CF, Ahlstorm U, Ericson S, Hugoson A, Thilander H**:* The influence of anatomical, pathophysiological and other factors on periodontal healing after impacted lower third molar surgery. A multiple regression analysis. J Clin Periodontol 18; 37-43, 1991.
59. ***Listgarten MA**:* Periodontal probing – what does it mean? J Clin Periodontol 5; 675-686, 1980.
60. ***Melcher AH*:** On the repair potential of periodontal tissues. J Periodontal 47; 256-260, 1976.
61. ***Michael RM, Mark FB, Eric LD, Thomas BD*:** Corticosteroids reduce postoperative morbidity after third molar surgery – A systemic review and meta-analysis. J Oral Maxillofac Surg 66(9); 1881-1894, 2008.

62. ***Nardy C, Michael A, Guy S, Yuval S*****:** The effect of informed consent on stress levels associated with extraction of impacted mandibular third molars. J Oral Maxillofac Surg 66(5); 878-881, 2008.
63. ***Norton LA, Proffit WR, Moore RR*****:** In vitro inhibition in the presence of histamine and endotoxins. J Periodontol 41; 153-157, 1970.
64. *Offenbacher S, Barros SP, Singer RE, Moss K, Williams RC, Beck JD*: Periodontal disease at the biofilm-gingival interface. J Periodontol 78; 1911, 2007.
65. ***Omer Waleed M*****:** Submucosal dexamethasone injection improves quality of life measures after third molar surgery – a comparative study. J Oral Maxillofac Surg 69(9); 2289-2297, 2011.
66. ***Osborne WH, Synder AJ, Tempel TR*****:** Attachment levels and crevicular depths at the distal of mandibular second molars following removal of adjacent third molars. J Periodontal 93-95; 1982.
67. ***Peng KY, Tseng YC, Shen EC, Chiu SC, Fu E, Huang YW:*** Mandibular second molar periodontal status after third molar extraction. J Periodontal 72(12); 1647-1651, 2001.
68. ***Peterson LJ*****:** Textbook of Oral Surgery. 1992.
69. ***Ricardo WC, Belmiro Cavalcanti EV*****:** Assessment of factors associated with surgical difficulty during removal of impacted lower third molars. J Oral Maxillofac Surg 69(11); 2714-2721, 2011.

70. ***Richardson D, Dodson T*:** Risk of periodontal defects after third molar surgery. An exercise in evidence-based clinical decision-making. Jr Oral Surg Oral Med Oral Pathol Oral Radiol Endod 100(2); 133, 2005.
71. ***Robb HM*:** Third molars, when they should be extracted? J Canad Dent Assoc 7; 185, 1941.
72. ***Romina BP, Alonso CL, Ignacio A, Nicolas Y, Joseph B, Prakesh SS*:** Is adjuvant Laser therapy effective for preventing pain, swelling and trismus after surgical removal of impacted mandibular third molars? A systemic review and meta analysis. J Oral Maxillofac Surg 70(8); 1789-1801, 2012.
73. ***Rosa AL, Carneiro MG, Lavrador MA, Novaes AB, Paulo S*:** Influence of flap design on periodontal healing of second molars after extraction of impacted mandibular third molars. Jr Oral Surg Oral Med Oral Pathol Oral Radiol Endod 93(4); 404-407, 2002.
74. ***Ruga E, Gallesio C, Boffano P*:** Platelet-rich fibrin and piezoelectric surgery: a safe technique for the prevention of periodontal complications in third molar surgery. J Craniofac Surg 22(5); 1951-1955, 2011.
75. ***Sam MG, Rohana KS, Darryl CT, Robert ML*:** Influence of a pedicle flap design on acute postoperative sequelae after lower third molar extraction. Int J Oral Maxillofac Surg 41(3); 371-375, 2012.
76. ***Sammartino G, Tia M, Marenzi G, di Lauro AE, D'Agostino E, Claudio PP*:** Use of autologous platelet-rich plasma (PRP) in

periodontal defect treatment after extraction of impacted mandibular third molars. J Oral Maxillofac Surg 63(6); 766-770, 2005.

77. ***Sandhu A, Sandhu S, Kaur T*****:** Comparison of two different flap designs in the surgical removal of bilateral impacted mandibular third molars. Int J Oral Maxillofac Surg 39(11); 1091-1096, 2010.
78. ***Schofield IDF, Kogon Donner SL*****:** Long term comparison of two surgical flap designs. J Can Dent Assoc 54(9); 690, 1988.
79. ***Seidu Ab, Abayomi AO, Akinola LL*****:** A randomized comparison of the effect of partial and total wound closure techniques on postoperative morbidity after mandibular third molar surgery. J Oral Maxillofac Surg 69(6); e24-e30, 2011.
80. ***Sridhar V, Wali GG, Shyla HN:*** Evaluation of the perioperative use of 0.2% chlorhexidine gluconate for the prevention of alveolar osteitis after the extraction of impacted mandibular third molars – a clinical study. J Maxillofac Oral Surg 10(2); 101-111, 2011.
81. ***Stephens RJ, APP G R and Foreman D.W*****:** Periodontal evaluation of two mucoperiosteal flaps used in removing impacted mandibular third molar. J Oral Maxillofac Surg 41; 719, 1983.
82. ***Suarez Cunqueiro*****:** Marginal flap versus paramarginal flap in impacted third molar surgery. A retrospective study. Jr Oral Surg Oral Med Oral Pathol Oral Radiol Endod 95(4); 403-408, 2003.
83. ***Susarla SM, Sharaf B, Dodson TB*****:** Do antibiotics reduce the frequency of surgical site infections after impacted mandibular third

molar surgery? Oral Maxillofac Surg Clin North Am 23(4); 541-546, 2011.

84. ***Szmyd L* :** Mucoperiosteal flap. Dent. Clin. North Am 15; 300, 1971.
85. ***Szmyd L, Hester WR*:** Crevicular depth of the second molar in impacted third molar surgery. J Oral Surg 21; 185-189, 1963.
86. ***Thomas B. Dodson*:** Management of mandibular third molar extraction sites to prevent periodontal defects. J Oral Maxillofac Surg 62; 1213-1224, 2004.
87. ***Woolf R.H, Malmquist J.P and Wright W.H*:** Third molar extractions: Periodontal implications of two flap design. Gen. Dent 26; 52, 1978.
88. ***Zeigler RS*:** Preventive dentistry – new concepts. Preventing periodontal pockets. Va Dent J 52; 11-13, 1975.